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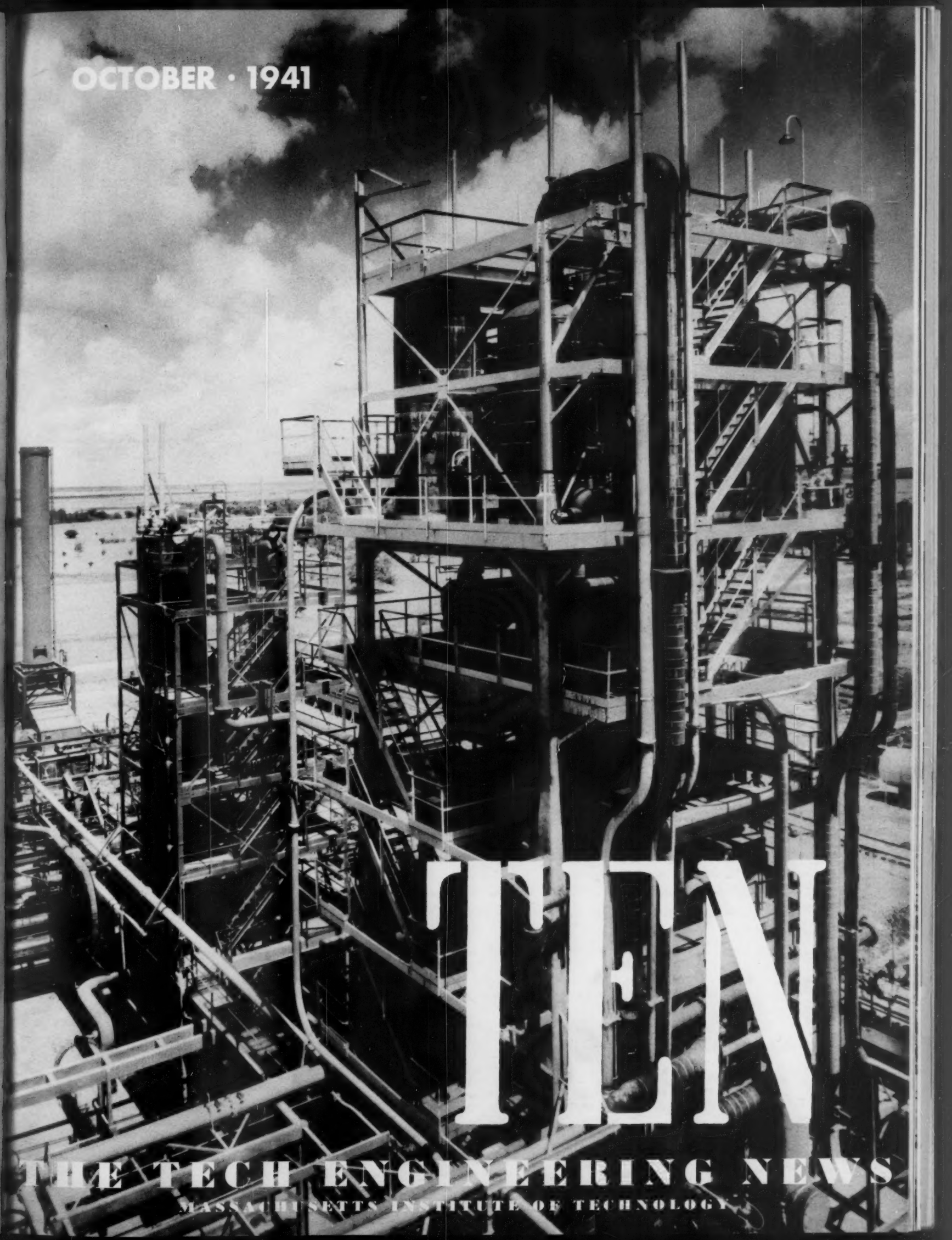

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THE TECH ENGINEERING NEWS

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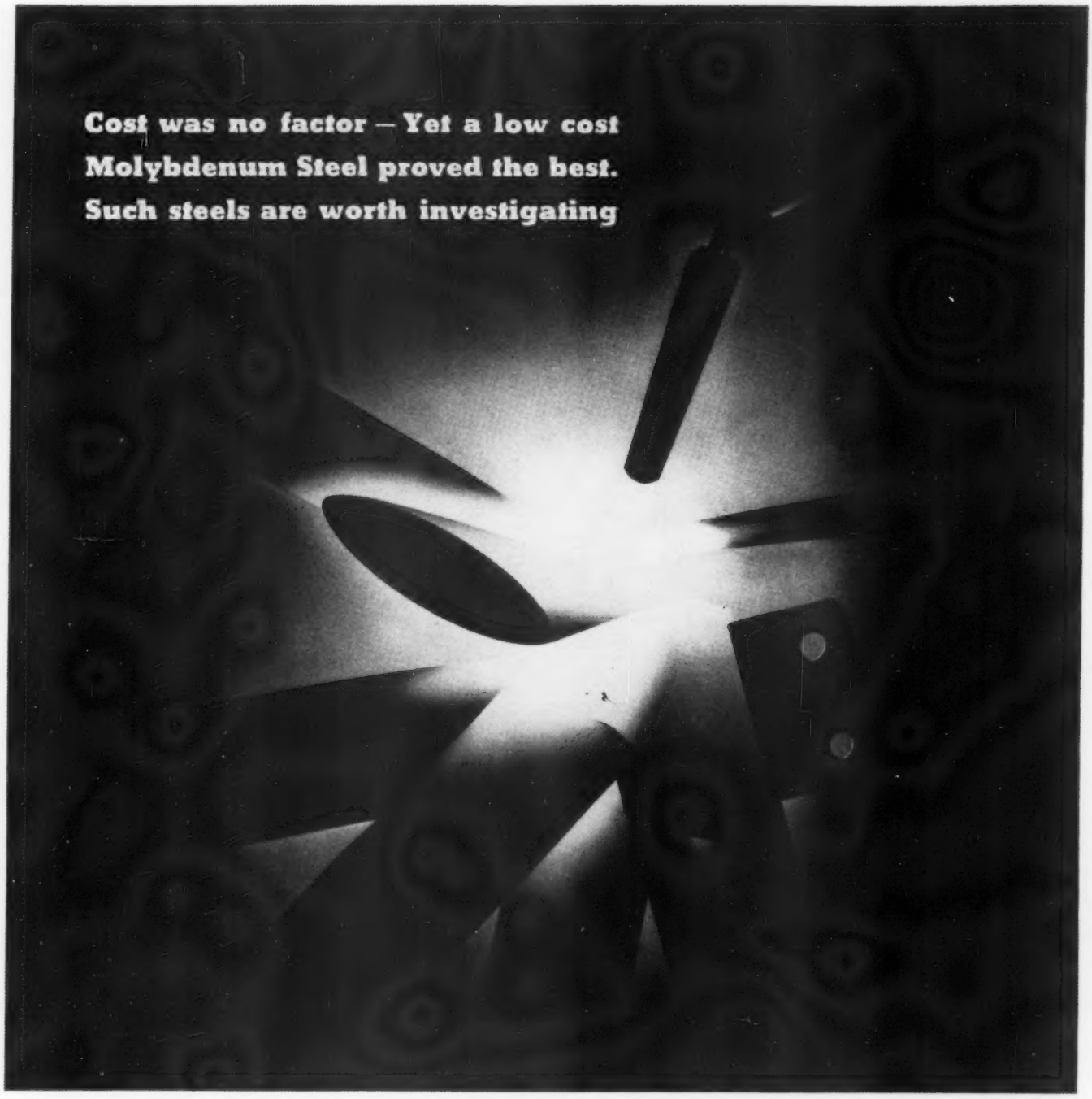

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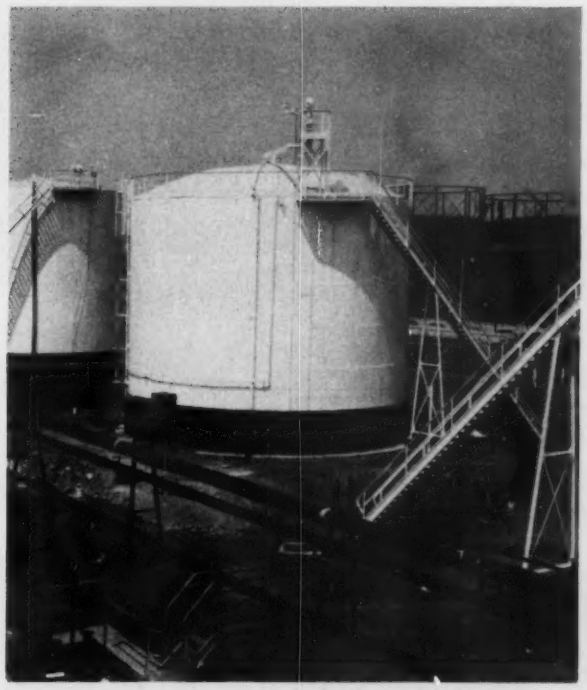

Courtesy Atlantic Refining Company

OUR COVER THIS MONTH
Atlantic Refining Company's new refinery at Atreco, Texas

VOLUME XXII
NUMBER 5

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MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

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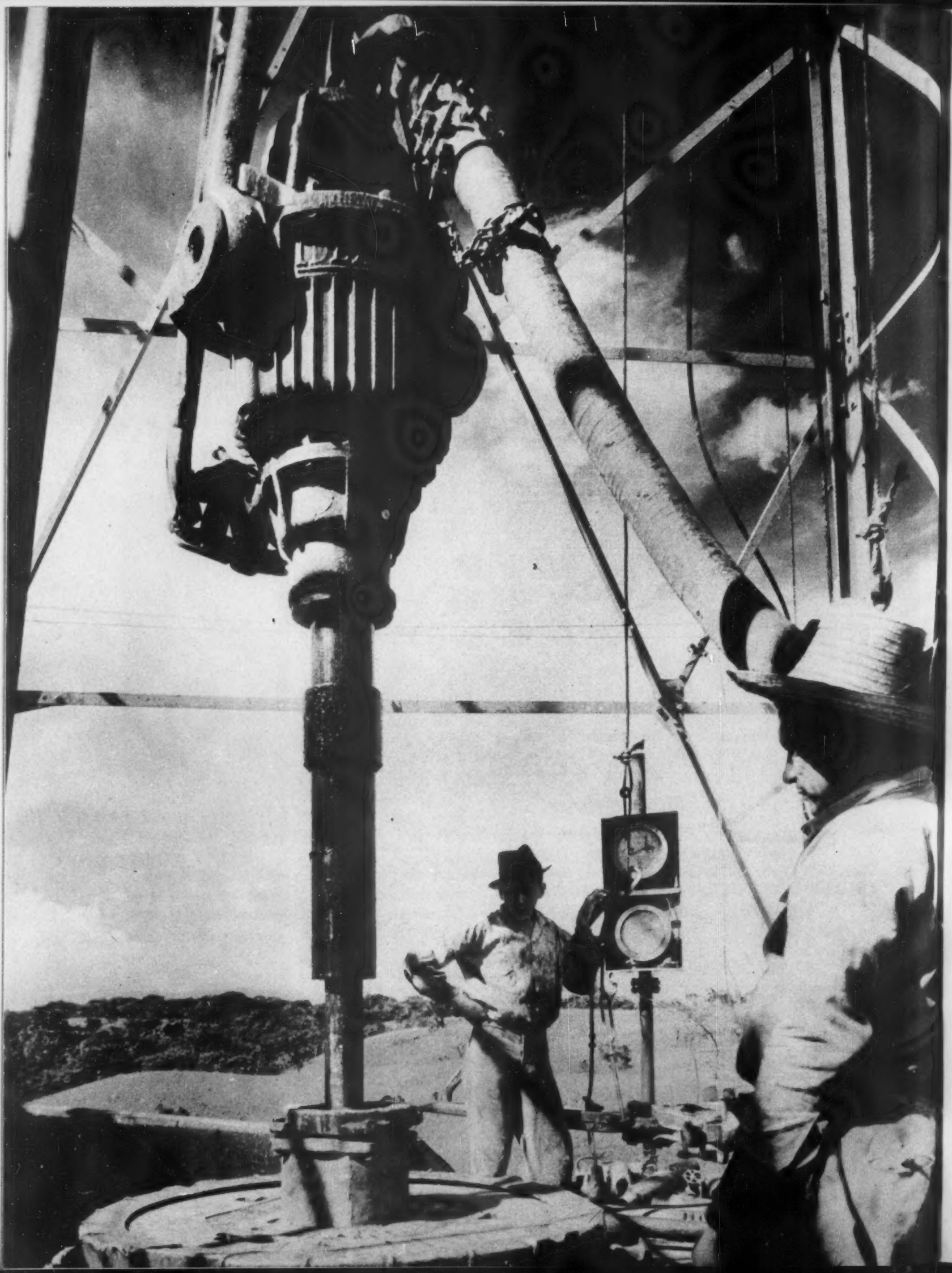


ARE YOU AFRAID OF AN OIL JOB?

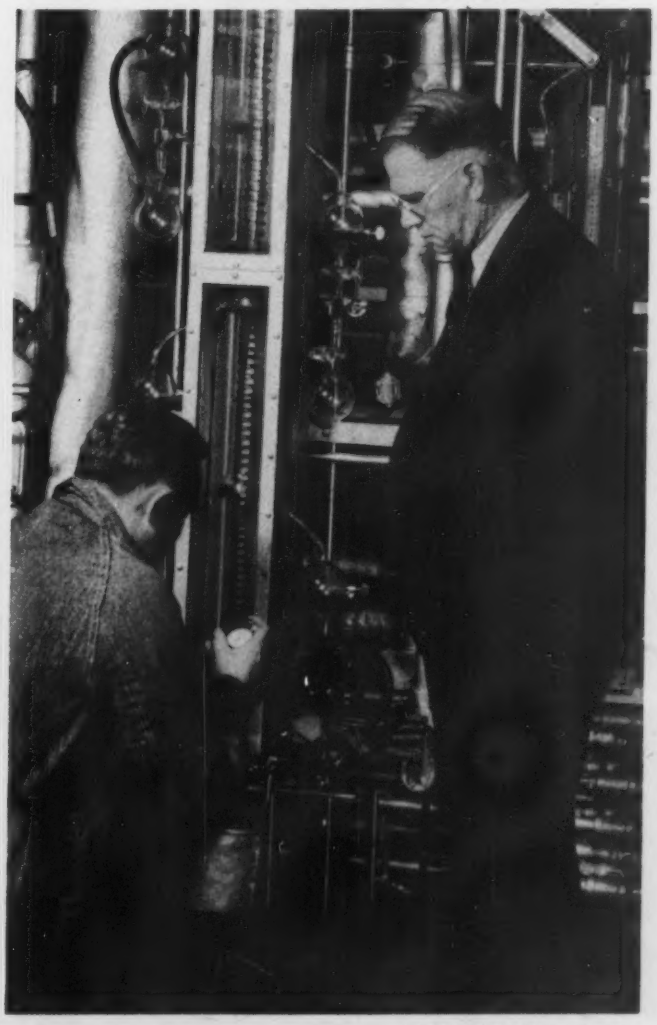
THE PETROLEUM INDUSTRY: ITS KNOWN RESERVES WILL LONG OUTLIVE YOU; ITS BY-PRODUCT INDUSTRIES ARE EVER INCREASING

By T. G. DELBRIDGE

MANAGER, RESEARCH AND DEVELOPMENT DEPARTMENT, THE ATLANTIC REFINING COMPANY

YOU who have the opportunity to study and learn in the Massachusetts Institute of Technology are thrice fortunate in having at your disposal a teaching staff, a library and other physical facilities without which technology is a pale, insipid undertaking. Along with this opportunity, there comes to each of you a changing responsibility — to apply yourself intelligently — to be ever on the alert for useful knowledge — to maintain your physical as well as mental health and growth — and as you near the time when you are ready to put your native and acquired talents to work, you have the responsibility, the necessary responsibility of selecting the field in which to make your contribution to better lives for your fellow men. That after all is the true goal toward which the technologist strives and though dollars may be part of your reward, you will find a deeper gratification in making a better world.

The need for technically trained men is greater today than ever before and this need is expanding into old industries now waking up, into new industries less than a decade old. The petroleum industry is both young and old: old in the sense that it is an octogenarian; young in the sense that it has the courage, the enthusiasm, the determination to advance that characterize the young man. The debt of the petroleum industry to M. I. T. is fully attested by the impressive list of Tech men competently and effectively serving in that field of technology. To some of you there may have come the fear that petroleum technology will have come to an end before you are ready to put aside active service. The basis for such fear is probably associated with the idea that the exhaustion of petroleum is not remote. Obviously no specific answer can be given to the question "How long will petroleum reserves last?" An examination of the known facts will remove some of this fear. If the 1908 official estimate of petroleum reserves had been correct we would have no petroleum today. If the 1918 estimate was right we ran out of oil eleven years ago. Yet in 1939 the estimate of *proven* reserves was enough to carry on to 1953 at the current rate. However, the technologist by improving methods of exploration, of drilling, of recovery, has opened up almost unsuspected possibilities in future reserves not yet proven. In 1859 the famous Drake well was 60 feet deep; in 1909 a deep well was 6,000 feet; in 1938 15,000 feet — almost three miles. In one Pennsylvania field, the water drive method has demonstrated a reserve greater than all the oil taken out of that field in seventy years. Therefore the "exhaustion" of petroleum reserves is not likely to come at any early date — certainly not in the lifetime of anyone now living.



The Atlantic Refining Company

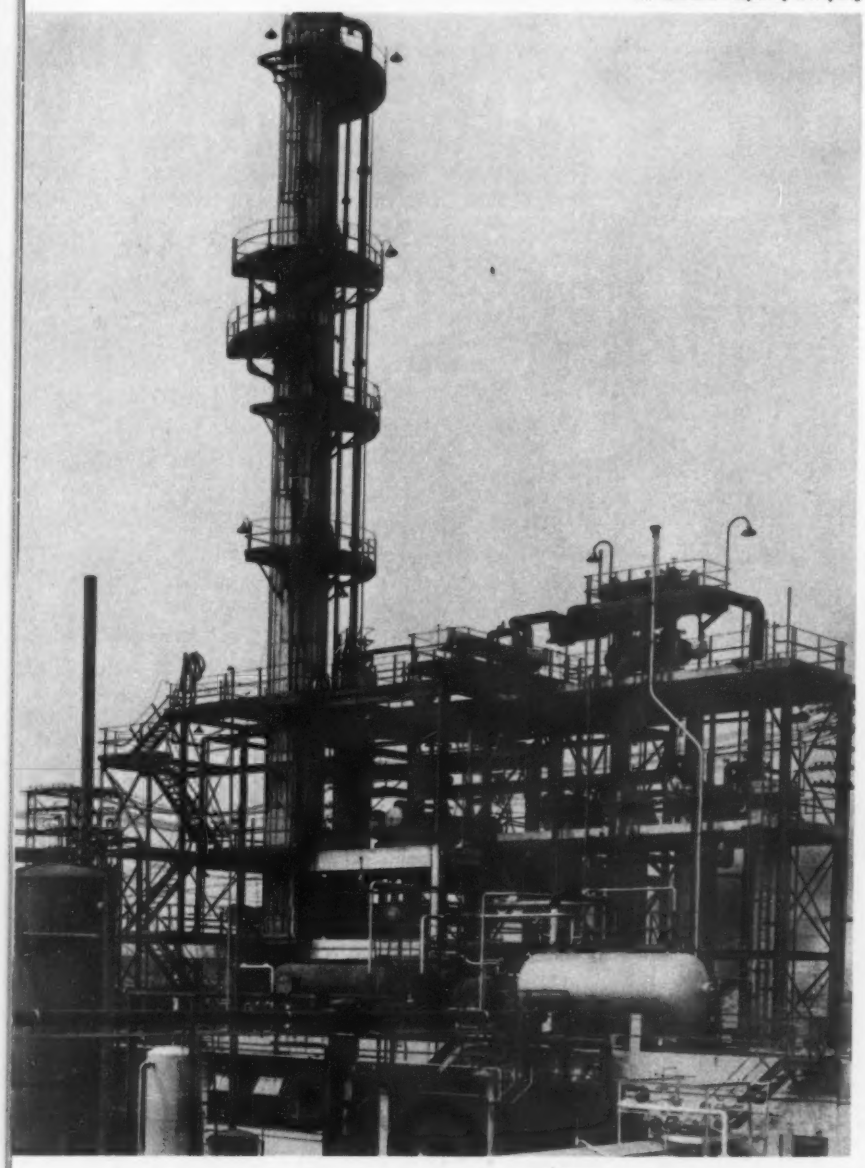
The author in one of the laboratories

At this point it may be well to point out that petroleum technology is a world job. We think of the United States as pre-eminent in oil. It must not be forgotten that foreign production, transportation, and refining have utilized American technologists. When the present crazy world has recovered its sanity, you may expect to find the American petroleum technologist applying his superior knowledge and experience to foreign fields, probably many of them not even discovered during your active lifetime.

But suppose you knew that petroleum would be completely exhausted in 1976. It will not be, but let us assume such a situation and that you still have ten or fifteen years of active work ahead of you. You will not be out of a job because long before petroleum is exhausted, you and your fellow technologists will be working up the other known reserves of bitumen such as coal, oil shale and the asphaltic sands. Or it may be that you will find the means to rework the abandoned oil wells of 1900 and recover three to four times as much as had ever been taken from them. Who would be better trained for such work than the petroleum technologist who started in 1942? To emphasize the writer's sincerity of opinion he ventures to quote a statement[1] máde two years ago, "If any of you have sons or grandsons or daughters or great-granddaughters who want to enter the petroleum industry, it probably offers a more permanent outlet for hard work and keen competition than almost any industry other than food or politics."

Catalytic polymerization plant at refinery of The Atlantic Refining Company, Philadelphia, Pa.

The Atlantic Refining Company



One familiar with the petroleum industry never loses a feeling of awe at its magnitude and diversity. Where many commodities for which the technologist is responsible are produced as pounds or gallons, petroleum products are produced and transported in thousands of barrels. A modern tanker carries 150,000 barrels of petroleum. The pipe line now under construction to the eastern seaboard will carry 250,000 barrels each twenty-four hours. The industry is one of vast volumes. Its diversity is likewise impressive. Products ranging from fixed gases to asphalt and coke; processes of the utmost complexity; apparatus combining large volume, great strength, long life and complicated instrumentation; special products for specific exacting duty; all these are a challenge to the knowledge, skill, ingenuity and perseverance of you who are to carry on in our field, whether it be exploration, production, transportation, refining or marketing with its modern sales service staff. No one with the background of your training can fail to find his niche in some of the industry's innumerable ramifications.

Nor is it necessary to find yourself a job with a "big" oil company, because more and more smaller companies are recognizing the potential value of well-trained technologists who like hard work and do not fear dirty work. If you prefer to be a "specialist," then one of the larger oil companies is a likely prospect. However, this gives you a choice from a score of them. For example, one of the smaller integrated companies, perhaps tenth in size, maintains a research organization of over two hundred at an annual expenditure of $800,000 per year. From this research department men have gone out to widely different responsible jobs, some of them, alas, to other companies. One M. I. T. graduate, after a few years of engineering work in our research department, evidenced ability and interest in human relationships, became personnel director for the research department and is now Industrial Relations Manager for the entire company. Alumni of oil company research departments include key men in every branch of the industry and not a few other industries are beginning to take men of experience in petroleum technology to work out problems in fuel utilization, lubrication, waterproofing, and even chemical synthesis.

Speaking of chemical synthesis, each of you interested in that line should not fail to inform himself as to the extremely rapid progress now being made using petroleum as the raw material. While toluene and rubber have had wide publicity in connection with our defense program, many other valuable contributions have come from the petroleum chemist and chemical engineer, among them representatives of most of the classes of pure organic compounds and many complex useful commercial products such as detergents, plastics and inhibitors.

In conclusion, two pieces of advice are offered. Do not consider going into petroleum technology unless you expect to have your fun through hard work. Second, if you come in, get all the training you can in advanced physics.

[1] American Society for Testing Materials, 1939 Presidential Address.

SITUATIONAL THINKING IN LABOR RELATIONS

THE ESTABLISHMENT OF A MUTUAL UNDERSTANDING BETWEEN ANTAGONISTIC GROUPS REQUIRES "THE POWER OF LISTENING TO WHAT IS *NOT* SAID . . . "

By PROF. PAUL PIGORS
PRESIDENT, INDUSTRIAL RELATIONS ASSOCIATES, INC.

The author of this article teaches, in the Industrial Relations section at the Institute, a course based on his own practical first-hand experience in labor relations work. A man who handles many kinds of problems of an industrial personnel relationship nature, he shows by a simple example how an individual trained and experienced in personnel work attempts to straighten out a problem fraught with antagonistic attitudes. Since industry needs and is demanding more and more men with an understanding of personnel relationships, we asked Professor Pigors for this article which gives the student an idea of the nature of personnel work.

IN a certain plant the workers were apprehensive as to management's intentions. They were afraid that management was planning to introduce a stretch-out (i.e., increase the work-load without extra compensation). A mass meeting was organized at which the membership proposed that the following clause be inserted in their pending labor contract. "It is further agreed that there shall be no abnormal increase in production and that 360 units of manufacture shall constitute the work per eight hour day."

The reader will notice that this clause actually contains two separate demands: (1) "There shall be no abnormal increase in production." (2) "360 units of manufacture shall constitute the work per eight hour day."

The first statement served an emotive function in expressing the fears of the workers that management intended to speed up production. It served no other useful purpose. The second statement contained the workers' demand, but is indefinite. In fact, as will appear from the following, in the light of management's preoccupation it was actually misleading. What the workers meant to convey was a demand that "360 units of manufacture shall constitute the work per eight hour day, unless other compensating factors are introduced." This was a question touching work-loads and a legitimate union concern. What their words did convey was "*management* shall be limited to the production of 360 units of manufacture per eight hour day." Interpreted in this way the demand referred to plant output, which was strictly a management concern.

In the subsequent negotiations the stage was all set for trouble. The inept formulation of the union's demand exasperated management and led to an acrimonious debate and greatly increased misunderstanding. Misled by the first clause and their own prejudices, executives interpreted the demand as an attempt on the part of organized labor to usurp management prerogatives. They reacted as follows: "Who is running this plant, anyway?" "Scheduling production is an accepted management prerogative and we cannot possibly countenance such revolutionary conduct." "Can't we increase production (meaning, increase output) if we want to?" Neither side specifically mentioned "work-loads." Each group was emotionally conditioned to respond only in terms of its habitual areas of interest. Management accused labor of trying to run the plant. The union accused management of trying to becloud the issue and to sweat profits out of labor. Instead of reaching an agreement with reference to the pending labor contract the two parties entrenched themselves on opposite sides so that conflict seemed imminent.

Men trained in situational thinking could have avoided this dilemma. An experienced staff official, taking a more inclusive view from his neutral position, immediately noted sentiments of mutual suspicion and hostility which were not explicitly stated by either party but were definitely part of the total situation. Next he called the attention of both sides to the sentiments that had been explicitly expressed but not mutually understood:

A. The workers were afraid of management's intention to increase production per-man per-hour without

(*Continued on page 126*)

Holyoke Water Power Co

THERE'S A WIDE FIELD OF CHOICE IN CONSTRUCTION ENGINEERING

By E. H. CAMERON
WITH JACKSON & MORELAND

Pungent, and to the point, Mr. Cameron illustrates from his personal experiences the various phases of construction work. The italics, which are ours, emphasize points of advice which all young engineers will do well to remember.

IS it out of place in a sober engineering discourse on the subject of construction organization to mention an early building project that is prominent in a worthy branch of our literature — The House That Jack Built? Surely, there was a fine structure, perfectly designed for all the exciting operations that ensued; and constructed, we may presume, on time and within the budget. When it came to getting things done, those folks knew how!

Primarily, it has been the *why* of things that has concerned you students thus far. While the *how* has undoubtedly received strong emphasis, too, soon you must learn *how* in deadly earnest. Your instruction will be involved then as it is now, but — you'd be surprised — with a distinction that is far from subtle. For in college you figure, make mistakes, and get corrected in a more or less polite manner. Later you'll figure, make more mistakes and get bawled out. But, God being good, soon you will be on the delivery end yourself and take your own diabolical pleasure in bawling out subsequent beginners.

You will learn *how* from various folks: some overalled chaps, maybe, who massage the levers of steam shovels; or, perhaps, fellows wearing draftsmen's aprons as they wield their tee squares. How good a construction man you'll become will depend, somewhat, on how wise you are in respecting the counsels of such men in minor rôles — men who are close to the dirt when it comes to practical ways of building a job.

As students of engineering theory you have wisely taken as gospel what your instructors taught. As field students of construction methods, later, it will be different. Some of the free advice given you will be punk, you'll discover. You must exercise your own good judgment and decide what advice is good and what is inferior. And you will quickly learn how to handle various elderly gentlemen, who, with their surfeit of good experience, must need pass on some of it to younger men. So pay respect to the gratuitous rules which are offered. You never can tell.

But another good rule is to get at what you are trying

to say without too many preliminaries. So, let's start on this construction project we are going to build and pick our gang.

First I must have a Promoter. He must have vision and much courage. Honesty must stand out in his makeup, for he has to inspire others with his own honest enthusiasm. Don't look on his card for the term "Promoter," but rather expect him to be called, "Vice-President in Charge of Development," or "Chairman of the Committee on Enlarged Facilities," or some similar title going with the function of industrial expansion. Forget all the opprobrium that, in late years, has been attached to the name, due to its association with certain dishonest stock salesmen. Such is a pure case of the prostitution of a fine term which has been honored by its reference to names like Eads, Stephenson, Wright and Ford. So pick me out a promoter from among you — someone having these superior qualifications.

But somebody's got to pay for all this, so let us pick our Owner; a name which occurs with monotonous frequency in the specifications, signifying "he who pays the bills." A tough hombre, usually, hardboiled to a high Brinnell figure, he will demand and darned well get a hundred cents worth of material and labor for every dollar of the monthly payment voucher. Some Owner will be paying you no matter where you work, so you must realize that his interests are paramount.

In school you learned to flavor your equations with dollar signs; as you build for the owner you'll have a chance to watch the working of these catalysts needful to get any reactions from your elements of construction. Our promoter having interested the owner in the proposed project, the latter asks: "How much," twice: "How much will it cost me, and how much will it return in the form of increased earnings due to the reduced operating expenses that it will cause?" Being a good promoter, the latter has an answer, of course, but everybody knows it's a guess; a good enough guess, however, to warrant further dicussion.

Let's stop and watch the owner and promoter as they toss about the terms, "Investment," "Earnings," and various "Fixed Charges," including "Interest," "Taxes," and "Depreciation," which, like the brook, run on forever whether the factory turns a wheel or not. Then they'll talk of "Operating Expenses," which include payroll, raw material costs, and similar expenses that will vary from month to month according to how many screwdrivers or locomotives this plant we are to build will turn out.

But it's still just tall guesswork! They need some honest gentleman who is capable of putting a measure to all this speculation. We must advise the owner to engage his "Consulting Engineer." He's got to be good — the man picked for consulting engineer. He must excel both in technical knowledge and fine traits of character. Like the doctor and lawyer, he gets hired because of his professional standing, and, naturally, must be a conservative cuss, who'll take no chances hazardous to the heavy assets in the form of experience and reputation that he has acquired.

With a mien that bodes ill to any stray bugs, technical or financial, that may have taken cover in the promoter's project, the consultant takes over. Scrutinizing such data as is available, he must sort the wheat from the chaff, the practical from the impractical. Enthusiastic hunches must be doused in the cold water of sound engineering analysis at this stage called Preliminary Study. Many schemes of development must be investigated. Perhaps we'd better call them "alternates," recalling the request of a certain sewer commissioner for elimination of the word "schemé" from one of our reports as too reminiscent of his own political progress and — he was afraid — too suggestive a tool to hand the political opposition.

Many of the schemes — or alternates — will demand elaborate designs and estimates; many may be dismissed as blind-alley ideas, not worthy of exploration. When he has finished his studies, the consulting engineer prepares his Engineering Report. It is something to conjure with — this report, this instrument whereby the owner is told how good or bad the preceding speculations on the merits of the project really are. For the consultant gets tough and makes every tub stand on its own bottom at every phase of the project under investigation.

Can't you see why I wanted the best man for this job — the man whom the owner will make judge, jury, and executioner in the subsequent proceedings? Now he can show his stuff as he designs his report. He will know, of course, the prime requisites of a good engineering report: clarity, force and proper emphasis. His language will be simple and his tabulations and curves understandable. Owners' minds, he realizes, can make the figures of their own balance sheets perform with acrobatic agility, but, at the same time, may fail entirely to respond to abstruse curves and drawings in an engineering report. Blueprints, to the uninitiate, naturally can be terrifying. Knowing this, our good consultant will not be afraid to make his exposition elementary to the *n*th degree. Owners like it that way. Curves aren't their line.

"The harsh cacophony of hoists and pile drivers . . ."

Courtesy Boston Edison Co.

So ours will be a good report, for, if our project has merit, we wish this fact to be emphasized rather than obscured in an aggregation of dollars, k.w.h. and b.t.u.s that only Einstein could fathom. Our project is not going to rest in an untimely grave under the headstone of a poorly designed engineering report.

We are lucky that our honest report was favorable to the project, for now the owner can arrange the financing and send the consultant that delightful letter to receive, the authorization to proceed with construction.

Exercising an owner's privilege, the owner has probably kept us waiting for months, even years, while he was making up his mind. His mind made up, he demands action, pronto: to hell with this manana stuff; get going! (Consulting engineers, you know, are paid to blink at owners' inconsistencies.)

But we can't blame the owner for demanding speed from now on; during construction he is undergoing a period of heavy outgo with no income, as far as the funds tied up in the project are concerned. Of course he wishes it to become a "Going Concern," with as little delay as possible. Being used to all this, the consultant calls in his hoop-jumping experts and starts organizing.

When you build a fire you must gather your sticks and tend the blaze. That takes organization. So does building a great factory, power plant, dam or bridge; after the gathering of bricks, lumber, stone, sand, cement, turbogenerators, pumps, fans, and what have you, you have your mechanics arrange these things into an integrated producing unit, which the Mayor or the Chairman of the Board can make bland speeches about as he dedicates this fine project of yours.

Someone's got to have charge of our organization so we will appoint a Project Manager. He starts by making a Project Schedule; the Bible of the job, by and at which men swear with fervent sincerity — the document that says what happens when.

Project schedules allot time periods for the preliminary field surveys, preparation of designs and plans, getting bids, placing contracts; and make allowance for the time spent in equipment factories, time needed to construct the building from the footings to the gold ball of the flagstaff, and time to erect and try out the equipment. Simple, isn't it? This project schedule is not just a promise of performance, but a working document of actual performance as well; with solid lines telling what you expected to do and (sometimes embarrassing) dotted ones beneath, which show how good you were in your original guess. It's nice when the lines match at the end and you find that you have made the grade, as you finish the last entry, the one reading, "Turn over to Owner."

But the owner's a worrying cuss. Time is important to him, true; but dollars cause him equal concern. Dog-gone him, he demands intimate knowledge of what is happening dollar-wise all through the job. He wants a Budget!

The budget, or what is sometimes called the "Revised Monthly Cost Estimate," was designed by some ingenious engineer to assuage owners' spirits in this respect. Pleasant peaks alternate with valleys of despair in this document which must tell to a penny for each item, every month, just what has been spent up to date, what are the outstanding obligations and the estimated cost to complete that item. Any one of you with a mean disposition and a good head for figures can have this job of keeping the budget.

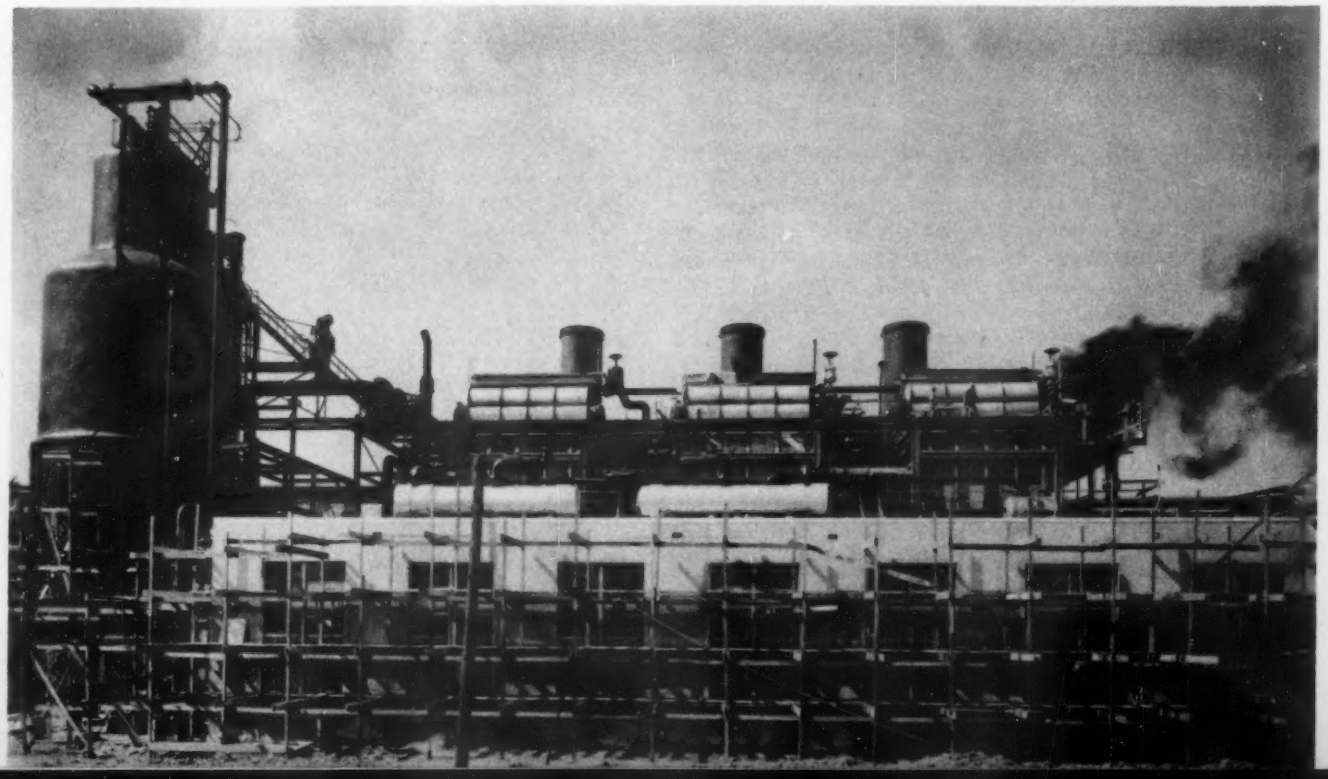
With the project schedule and initial budget done, the consulting engineer will put lots of you at work at jobs — or in responsible positions, if that makes for greater pleasure as you help him prepare to build the job. Congratulations to those of you who land in the drafting room — provided you'll promise to get discontented after a year or two and get out of it. It is a fascinating form of discipline, the function of taking computations, and with dimensions from handbooks and catalogues, creating a visual image of what is to be built — an image in flat, two-dimensional scope. Yet, by your ingenuity, you shall have rendered a perfect picture that the mechanic can understand for building a three-dimensional reality. Think constantly of this mechanic as you wiggle that tee square and slide that triangle. He will love you for it.

Once our boss, who was a contractor of much sense, took pity as he watched our conscientious struggles over a footing layout. "Close your eyes and start thinking," he said. "I've fired you as a draftsman and hired you as a foreman. Your first job is to put in these footings. Step by step, lay out your work. How will you get the pile driver onto the marsh? Now build the forms for the concrete. How will you hold up the reinforcing steel? You have pyramidal footings, notice. How will you keep them from floating up under the hydraulic head of the wet concrete?

(Continued on page 118)

"Proceed with Construction"

Courtesy The Texas Co.



ENGINEERING IN JEWELRY

IN ONE OF THE MORE ARTISTIC INDUSTRIES THERE ARE STILL PROBLEMS TO BE SOLVED BY THE ENGINEER

By MYRON EVERTS

SECRETARY-TREASURER ARTHUR A. EVERTS COMPANY, DALLAS, TEXAS

SOMETIMES it is hard to tell where science and engineering end and art begins. In manufacturing departments of jewelry stores all over the country experimentation is going on continually.

Take lavender gold. "Up in the shop" of the Arthur A. Everts Company the craftsmen are now experimenting with lavender gold. We hope some day to be able to use it in manufacturing jewelry. If the idea of lavender gold seems whimsical or far-fetched, we have only to recall the period of experimentation with white gold. Today so many articles of jewelry are made from white gold that we wonder how we ever managed to get along without it. However, we learned to work with white gold only after a long period of trial.

When white gold first came into use a number of years ago many people knew how to make the gold white but manufacturing anything from it after the gold became white was a different story. In heating for the manufacturing process the entire interior structure of the white gold would change and many mountings were ruined. The gold seemed to get a fever with complications.

In the days of experimentation, a well-known jewelry firm tested a one-inch cube of white gold by connecting it with a recording pyrometer. This cube was heated red hot and allowed to cool. During the cooling it was noted that the white gold raised its own temperature three times with rearrangement of the molecules. By chemistry, physics and engineering this trouble has been overcome, but even today there are many things that one cannot do with white gold.

The average person would never consider engineering as related to a platinum and diamond clip gleaming against the silk of an evening gown, but some knowledge of engineering necessarily goes into the construction of a fine pin. In the Southwest many customers desiring specially created jewelry bring in their own penciled sketches for pins, clips or ring mountings to our manufacturing department, but few of these sketches can be used because the jeweler's design must follow rules as definite as those for bridge building. A fine platinum brooch has a gallery running around the edge, comparable to a girder, which gives the pin strength. Usually where the pin is applied to the jeweled piece it must be reinforced with a heavier metal or with several layers of the same metal.

In a jeweler's manufacturing department the craftsmen learn by apprenticeship rather than formal schooling. Most of them spend a lifetime repairing and fashioning jeweled pieces. This is a craft with few textbooks. Secrecy is the rule, since a workman who has labored for months perfecting a product does not care to have his formula known.

There is a surprising degree of originality, both in design and in materials, shown in this craft without textbooks. Scores of different formulas are used for white and pink gold. The material desired may be hard, soft, brittle, ductile or springy gold; each is made by a different formula. Platinum jewelry is also made from several combinations. Sometimes the alloy is palladium which has a low specific gravity and a consequent greater bulk, making the metal "go further." In the more expensive platinum jewelry, the alloy is iridium, selected for hardness.

Electroplating and casting are two everyday processes up in the shop that offer as many hazards as a Texas norther.

All that is known about electroplating by jewelers

has been learned the hard way — by experimentation over a long time. Some of the problems that have kept us awake at night have arisen from electroplating. A particular offender here is pink gold. This material can be electroplated nicely, taking a good finish, but that is not the end. With wear the copper of pink gold seems to bleed to the surface of the metal where it tarnishes and wears off, leaving gold of an entirely different color. In electroplating, a variation of current and voltage will also cause a variation in color, as will a change of temperature in the plating bath.

A craftsman can become almost distracted casting precious metals. The type of alloy must be selected according to what sort of gold is desired. Every next detail has a bearing on the outcome — the pressure under which the metal is forced into the mold, the size of the vents, the composition of the mold, that is whether the mold is of cuttlefish bone, sand or plaster.

Heat, so necessary to the manipulation of metals, also furnishes many a problem. During soldering jobs in the Everts manufacturing department, for many years stones in rings and pins were removed from their settings to protect the stones from heat. Then it was discovered that the stones could be protected by wrapping them in wet paper. It is still thought necessary to remove pearls, the gems most susceptible to heat, which may be damaged beyond reclaim by extreme changes in temperature.

Engraving is another phase of the work in the shop which has gained from experimentation. Most engravers have made their several hundred tools themselves. It may be interesting here to mention that this is the only art in which the artist works outward instead of toward the body. Beyond the processes of engraving these men have problems to be solved by science. A hard spot in the metal being engraved will cause the workman's tools to slide. Elimination of such hard spots is a boon to the engraver. When an engraver makes a mistake he cannot use an eraser.

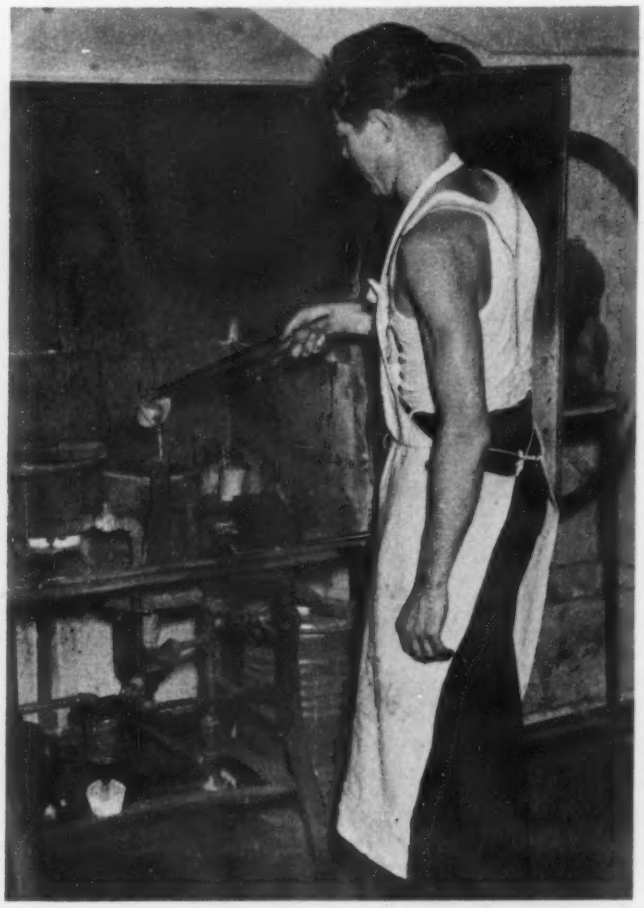
Watches are not made up in the shop but every idiosyncrasy of watch mechanism must be known. Problems of the watch are astronomical in number. When you venture into the realm of accurate timekeeping, you venture where angels fear to tread. The public does not recognize a watch as a fine mechanism or even as a piece of machinery. A watch balance, if kept rolling for one year, would roll from New York to San Francisco, but there are still people who object to oiling a watch.

Should everything else go right, we still have with us the mainspring. Today, as a couple of centuries ago, mainsprings break without rhyme or reason. Such acts of nature as a thunderstorm damage mainsprings, this prima donna of the watch mechanism. Strangely, a good mainspring will break more readily than a cheap one. Major engineering problems of the watch which are now solved include the provision of uniform power from the mainspring and the problem of compensating for temperature changes within the watch so that the rate may remain the same. Another victory in experimentation with timepieces led to the correction for

(*Continued on page 120*)

Before this engraver in the Everts shop are a few of the several hundred tools he has made, himself. He is engraving a ring clamped into the engraver's block.

Lavender gold. In such unromantic surroundings a new form of gold is being evolved to adorn milady. Here a bit of it is being poured from a crucible.



PLACID PRODUCTION

HEALTH OF THE WORKER—THE ALL-IMPORTANT YET OFTEN FORGOTTEN LINK IN MASS PRODUCTION

By HENRY G. COX
MANAGER MAGNETO DIVISION OF J. I. CASE CO.

PHYSICIANS say that we Americans work too fiercely and play too hard and as a result eighty per cent of us are getting high blood pressure, or heart disease, or nervous systems shot to pieces.

This country is noted for its mass production in which things are manufactured at high speed, but under great nervous tension. So it seems to the writer that it is about time that we should use our Yankee ingenuity to study this very complicated machine called the human body, in which we live, and try to get the most out of it with the least nervous strain, or wear and tear.

The Mayo Clinic says that when you cut your finger only your finger is sick, but when your nervous system is affected your whole body and mind are sick, so our problem is to manufacture rapidly without creating nervous tension.

The J. I. Case Company wished to make a magneto of higher quality and performance than any they could buy, so they gave the writer the job of designing such a magneto, and then designing the factory in which it would be made, and since it was to be a high quality product, here was an opportunity to prove that precision work could be done rapidly, yet with ease.

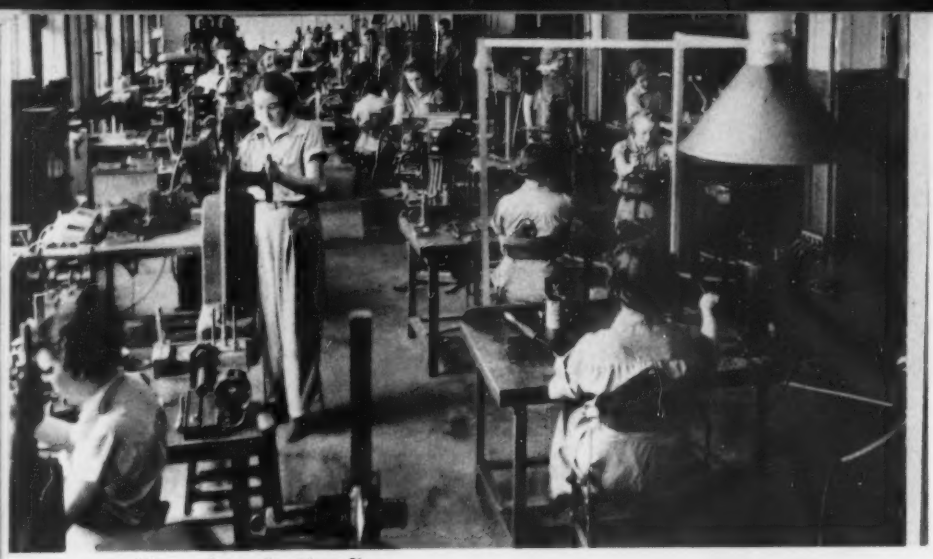
Piecework was prohibited, because piecework lays all emphasis on speed, not on quality, so every job was made on a day rate basis and the speed was set by a conveyor line.

Most conveyor lines are assembly lines with machine work done somewhere else, then brought to the line to be assembled into the finished product, but in this factory a conveyor line was used for all machine operations such as lathe, milling machines, drill presses, grinders, rivet spinners, rubber molding, with every job four and one-half minutes long.

Each operator on this conveyor line tests his own work with gages and micrometers, and also acts as an inspector on work done by a previous operator on the line. Assembling the finished product, twenty-four hour testing, and the final dismantling and finish check-up are also done on this line and they never miss a basket, unless some major catastrophe happens to a machine.

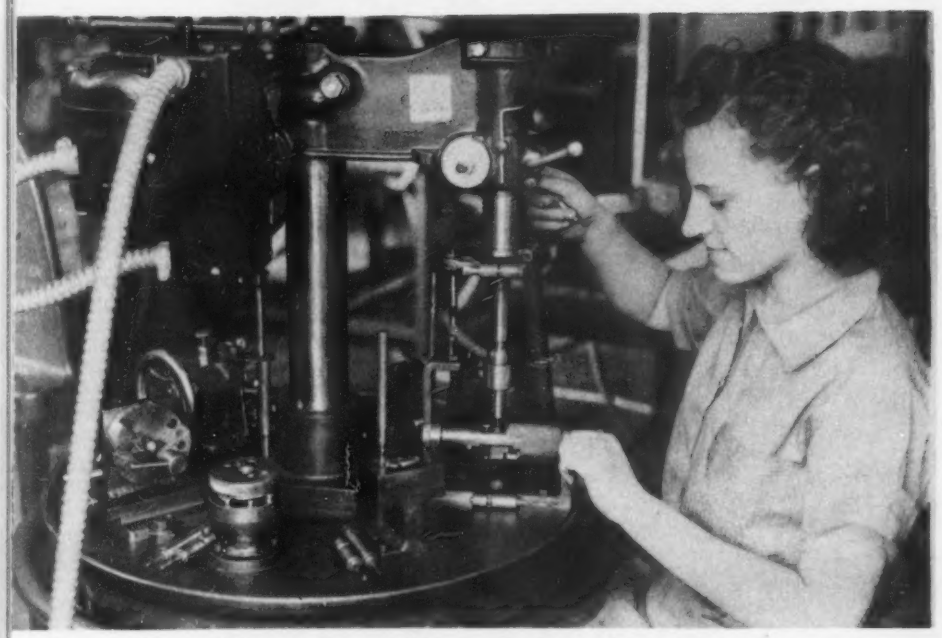
When an operator has spoiled his own work or finds that the work of another operator he is inspecting is spoiled, he blows one blast on a whistle which brings the Chief Inspector to him to get the spoiled part, but since the Chief Inspector might not get there before the basket passes, he has an extra, perfect part of his own, and an extra, perfect part of the operator's whose work he inspects that he can put in the basket if necessary. When the Chief Inspector takes these spoiled parts, he gives the operator other completed perfect parts which have been made by swing operators.

Swing operators know every job in the room and can step into those jobs when any operator is absent, or when a new operator who is being broken in needs help, but when everyone is present the swing operators make extra parts to replace those that have been spoiled in manufacture. When an operator falls behind because of trouble with the material he is working on, he may call a swing operator to help until he catches up.



View of production line

Loading a basket with unfinished parts taken from the rotating bins



Turntable makes one drill press do the work of many

The Chief Inspector never reprimands any operator for spoiled work. If an operator becomes careless and spoils more than is permissible the Superintendent does the reprimanding, so that the Chief Inspector remains a friend of each worker.

If an operator breaks a drill he blows two blasts on his whistle and the Maintenance Man immediately comes and gives the operator a new drill, or hones a boring bar, or grinds a lathe tool, but in any case he is on instant call in answer to the whistle. The Maintenance Man never reprimands the operator but leaves that to the Superintendent, in case the operator is abusing the machine, so again he is a friend who makes quick repairs — not someone for the operators to fear or dislike.

However, every day the spoiled work made the previous day is placed on a table and the Chief Inspector, the Maintenance Man and the Division Manager inspect it. The money cost of each spoiled piece is known, and each day an attempt is made by these three to prevent the repetition of this spoiled work, by finding out how it was spoiled, and correcting that cause. They ask this question about each piece — Was it the fault of the operator, or of the machine, or of the material? If it was the operator's fault it is recorded, like a baseball player's record of hits, runs or errors, and the operator is cautioned against repeating it. If it was the machine's fault immediate repairs are made. If it was the material's fault it is returned to the maker for credit. In this method of manufacture spoiled work is caught the instant it has been made, and this makes all the operators "spoiled-work" conscious.

So here is manufacture free from worry, fear or strain, and when these are absent it is amazing how fast the fingers fly, for relaxing from strain does not mean slowing down in speed of operation; quite the opposite, it makes our bodies do their best because they are relaxed. Lawrence Tibbett said he could not sing his best until he learned to relax. You cannot do your best in golf unless you relax, either.

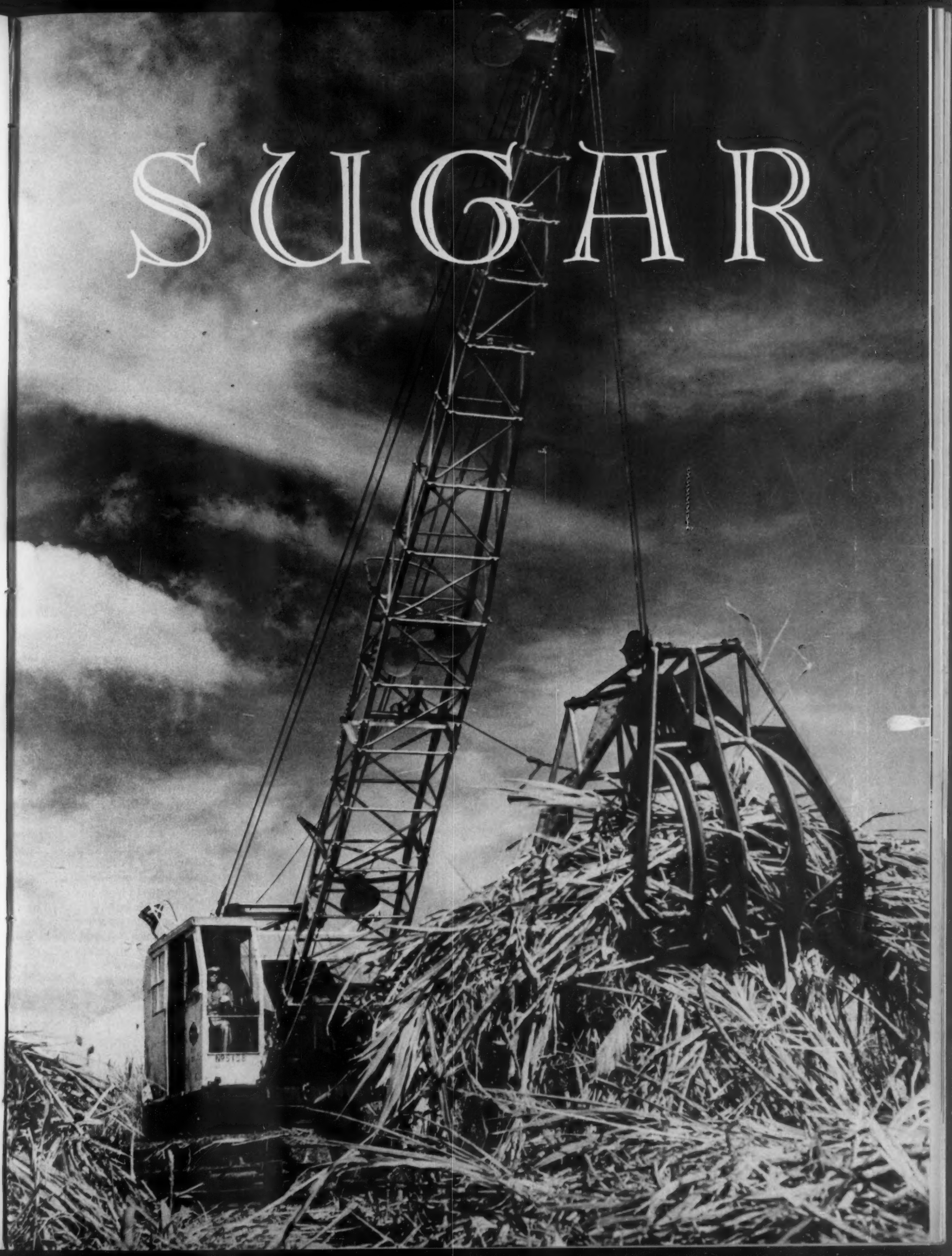
Operators who sit have chairs fitted to them. Steps are saved wherever possible; eight drill presses in a 25-foot row, causing a 50-foot walk 100 times a day, have been condensed into one drill press in the center of a ball bearing table with eight jigs or fixtures on it and a quick change chuck on the spindle. The operator sits at the press instead of having to walk to the different drill presses.

Hard rubber is used in the distributor disc and distributor block instead of Bakelite because it is self-curing if a high-tension spark runs across its surface, where Bakelite will burn a carbon path and keep on burning clear through the piece if the spark is allowed to follow it. These rubber-molded parts are cooked in an 18 foot long vulcanizer under 11,000 pounds pressure and 340° steam heat.

The condensers, which are the most sensitive part of a magneto, are wound in a filtered-air room and the operators who wind these condensers are dressed in vacuumed clothes. Since the electric charge resides between and touching both the tin foil and the paper against

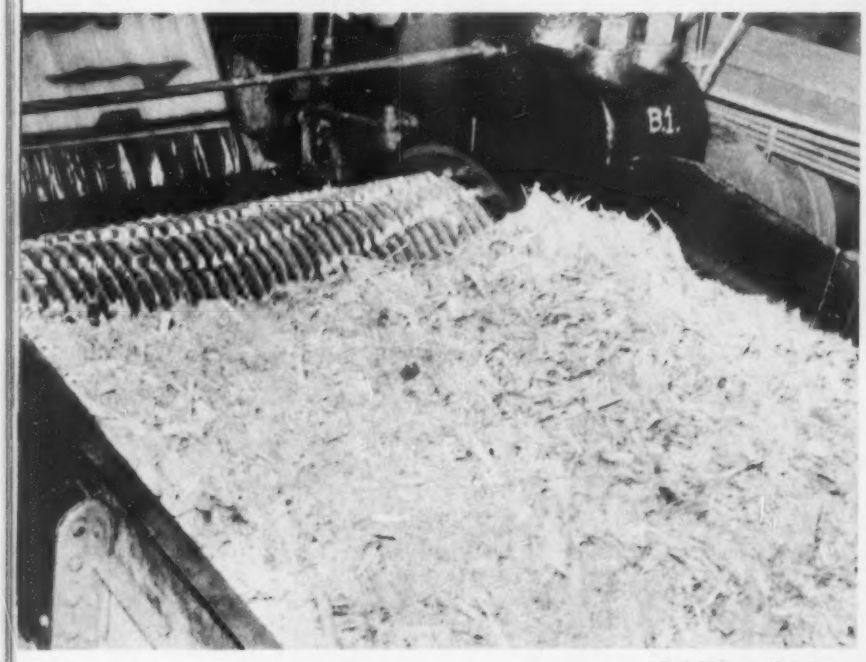
(*Continued on page 122*)

SUGAR



SUGAR MANUFACTURE . . .

is a process industry little known among engineers in this country, except in Louisiana and Florida. From Cuba, the West Indies, India, Java, Hawaii, and the Philippines flow 26,000,000 tons of sugar annually to nations all over the earth.



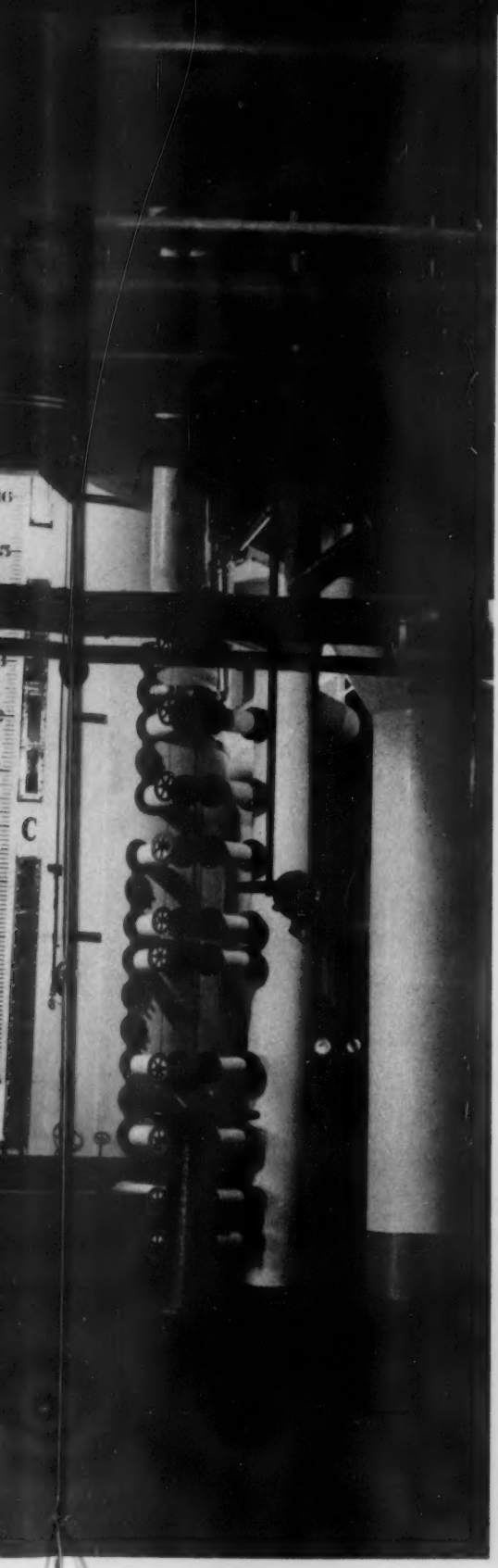
C. & H. Sugar Ref. Corp.

THE operations of the raw sugar industry begin after the cane, a giant perennial grass which thrives especially well in most tropical climates, is hewn down and transported to a nearby plantation factory or "mill." (Shown on page 113 is one of the large "grab" harvesters used today in the Territory of Hawaii. In its jaws is a part of America's large annual crop of domestic sugar.) Rapid deterioration of the stalks dictates the proximity of a factory on every large plantation. In these "mills" the sugar is seldom refined to one hundred per cent purity; rather, the raw amber crystals are sent to refineries across the seas, which, in this country, are in California or on the Atlantic Seaboard.

An almost sickeningly pungent odor of sweet molasses betrays the location of the mill. Here the first process begins as the cane thrashes through laterally

Sugar cane being ground and crushed at the start of processing

(Above) Vacuum pans, where sugar is boiled at low temperature until crystallization is complete



flexible steel blades set approximately six inches apart. After leaving this step the cane is in small pieces resembling chips and is thus prepared for efficient milling. Sieving hammers then receive the cane and "chomp" it into a fluffy mass on an anvil. On the mass shoots to the rollers; these grooved rollers are in sets of three (one above the other two), and on each top roller is a hydraulic ram exerting a force of from four to five hundred tons. Water is sprayed on the nearly dry chaff as it passes through the rollers followed by diluted juice from the troughs below. This process, which is known in the sugar industry as "maceration," greatly increases the extraction of sucrose from the cane, without adding an excessive volume of water. Without further drying, the fibre residual, bagasse, may become fuel for the furnace of the factory's power plant.

As early as is possible in this set of operations the maximum amount of impurities must be removed from the juice. From the roller troughs the liquid is pumped through strainers of perforated brass into six thousand gallon capacity, conical-bottomed heating tanks. Calcium hydroxide is added to neutralize acids and to precipitate calcium phosphate. As heating coils become charged with live steam, the insoluble sediments form, carrying down with them coarse supersoids, and occluding the colloids of albumin, varying proportions of fat, wax, and gums. From this treatment emerges a clear liquid.

Before the liquor can become saturated, a large part of the water must be evaporated. Since ordinarily sugar would caramel at the boiling point of the solution, evaporation must occur in a vacuum and thus at a lower temperature. Highly efficient are the multiple effects in which this is done. In vertical cylindrical vessels, horizontally divided brass steam chambers, the juice boils away to lower density. Steam arising from the juice in one bubbling caldron provides heat for the succeeding cyclic effect. As the total heat decreases in each reaction, the vacuum becomes more intense, rising from sixteen to ninety-three per cent of the absolute void.

The thickened syrup, yet unsaturated, is now ready for crystallization in cast-iron "vacuum pans." Vapors from the sluggish mass condense into water. After a period of rapid boiling, microscopic crystals begin to form. The "graining point" has been reached. Highly skilled operators charge the raw mixture with more syrup, after which they delicately culture and sample their crystals. "Strike!" The bottom gate opens, air rushes in, and sticky lava-like "massecuite" blurps out of the pan.

(*Continued on page 125*)

(Below, left) Weighing and filling 2 pound, 5 pound, 10 pound and 25 pound pockets of sugar in a California sugar plant *C .& H. Sugar Ref. Corp.*

(Below, right) Slabs of crystalline sugar pass on to final cutting and packaging *C. & H. Sugar Ref. Corp.*

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FRANKLY SPEAKING...

LET'S GET OUT OF THE MIRE!

In his call-for-unity speech last May, President Roosevelt asked for co-operation from both management and labor, strongly suggesting that any and all recalcitrants would be reprimanded. According to recent War Department figures, 421,000 man-days of work on its contracts were lost in August because of strikes as against a July loss of 286,000 man-days. From January 1 to September 1, nearly 3,200,000 man-days were lost to Hitler's advantage. The following table published by *Life* magazine shows in dramatic manner how much military equipment is unavailable because of this lost time:

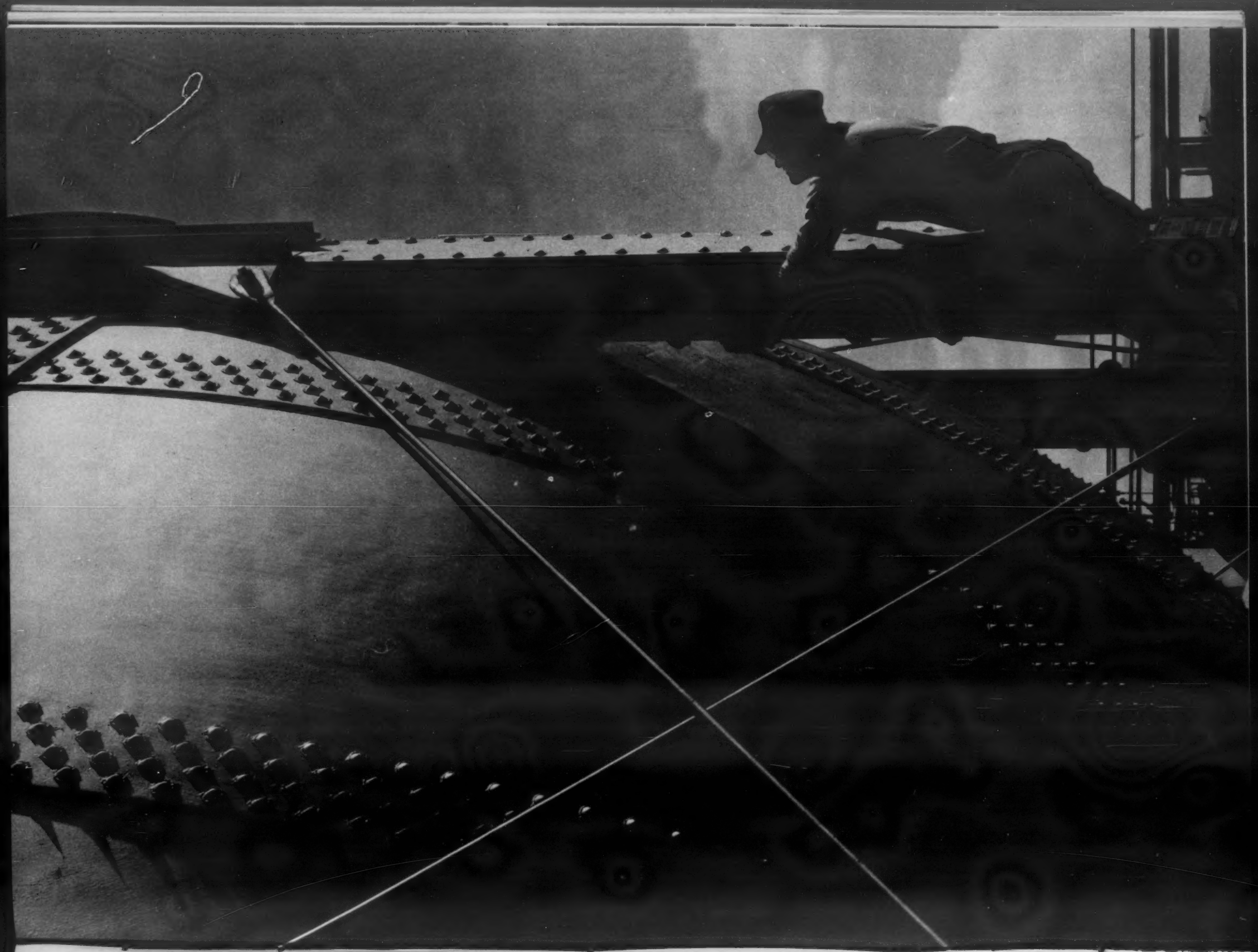
1,000 Curtiss P-40 fighter planes
800 13-ton tanks
20,000 50-cal. machine guns
1,000 75-mm. gun mounts
100,000 Garand rifles

Is this the sort of unity and co-operation that is supposed to help the defense effort? What has the government done about it?

"Today," cried President Roosevelt in his Labor Day broadcast, "the chief American fighters in the battles now raging are those engaged in American industry. . . . No group of Americans has realized more clearly what Nazi domination of the world means than has organized labor."

We wonder: DOES labor realize so well what Nazi domination means? How about the lost hours and lost production mentioned above? Looks to us as though labor, or at least its leadership, is more interested in taking advantage of defense to further entrench itself and get sweeping new powers.

Somehow it does not seem fair to us that the men and women, the so-called "chief American fighters in the battles now raging," who make up American labor, are allowed to slow down the national defense effort through strikes over localized incidents and the like while thousands of men have to give up civilian jobs to serve two and one-half years in the Army where they can not strike, where the pay is small, and where there is often inadequate material for training purposes. We are of the opinion that one way to help build up army morale would be for the government to stop fostering and encouraging the present shameful labor condition existing in this country today. We fail to see how this government can expect national unity when it allows irresponsible, selfish labor leadership to call strikes when and as it pleases. We still look hopefully for the day when this country will have an enlightened labor leadership which would not vex the public with strikes that tie up whole industries because of some small localized incident.



"You will learn from various folks . . ." *Courtesy Boston Edison Co*

"PICK YOUR JOB, SIR"

(*Continued from page 108*)

"Now, open your eyes and go at that drawing again." Thus a practical man's counsels to a green youngster.

Be an honest draftsman, too. Remember that owner again, who is paying the bills. This thing of joy to all from the chief draftsman to the job superintendent, a good drawing, may defeat itself if it becomes too intricate. Avoid the inaccuracy of too fine a precision. Accuracy being relative, micrometer precision in spacing timber piles is as wrong as the allowance of a one-inch tolerance for the mainspring diameter of your watch. You will learn the degree of precision required and find it difficult enough at that.

Lots of people, some of them your superiors in the office, perhaps, never seemed to learn this. Be courageous in a polite manner when they ask you for dimensions carried to sixteenths of an inch when your common sense tells you that one-eighths are sufficient.

We've another job to fill at this stage, that of Specification Writer. Who is the fellow among you that did well in English Composition and Business Law? Let's examine a few of his other qualifications before we take him on. First, is he eminently fair? Has he the mind of an encyclopedist — he's got to know everything, you know — is his imagination equal to Shakespeare's, and his vision like the Apostle Paul's? Then he'll do.

Perhaps he deserves a more resounding title such as Contract Manager, since he is responsible for the preparation and the operation of the contract documents that are necessary if the three parties of the agreement under which our job is to be built are to work together in harmony: the owner, contractor and engineer. What are these documents? Advertisement, Invitation to Bidders, Proposal (on which the bid is made out), Contract Agreement (with its general legal provisions and technical specifications), and the Drawings.

Before we turn him loose there is an important counsel for our contract manager, in view of his peculiar function as an agent of the consulting engineer. The engineer is paid by the owner; yet, in the agreement between the owner and contractor, the engineer is defined as the man who is to enforce the terms of that agreement.

Do you get it? How do you feel — you whom we have chosen as consulting engineer? Are you good for it? Can you act as judge in a court that is maintained by the plaintiff, and still render fair decisions for the defendant (the contractor), so that the latter may get justice without having to appeal to the arbitration clause that is at the end of your general provisions?

What other profession do you know of that demands such a high sense of fairness and integrity of its members? Are you not a little proud to be a member of a profession that the building fraternity has honored for generations with this position of high trust?

Luckily, unfair owners are few, perhaps equal to the contractors of the same ilk, but, just in case, how about a little brisk exercise of the intestinal muscular system? It will help, as you struggle with the occasional owner who refuses to be fair. He's paying you, so go along with him to decent limits, but stop there.

By now you're probably getting impatient; certainly the owner is becoming so — months of work and not a shovel turned and with nothing to show but a few acres of blueprints. Let's make everybody happy by placing some contracts — the general building contract and

(*Continued on page 128*)

for utmost service to the Nation

In these critical times, communications play a vital part in defense. Here is how the Bell System is organized to meet its great responsibility.

American Telephone and Telegraph Company coordinates all system activities, advises on telephone operation, searches for improved methods.

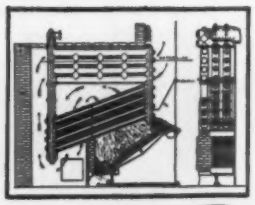
24 associated operating companies provide telephone service in their respective territories.

Long Lines Department of A.T.&T. interconnects the 24 operating companies, handles Long Distance and overseas service.

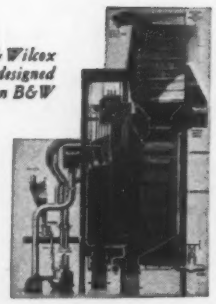
Bell Telephone Laboratories carries on scientific research and development for the system.

Western Electric is the manufacturing, purchasing and distributing unit.

Highly trained through many years of working together, these Bell System companies provide a nation-wide, unified service. Never have the benefits of this system been so clear as today when the country is under pressure.



The original Babcock & Wilcox Water Tube Boiler—designed in 1867—and a modern B&W Boiler.



The
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ENGINEERING IN JEWELRY

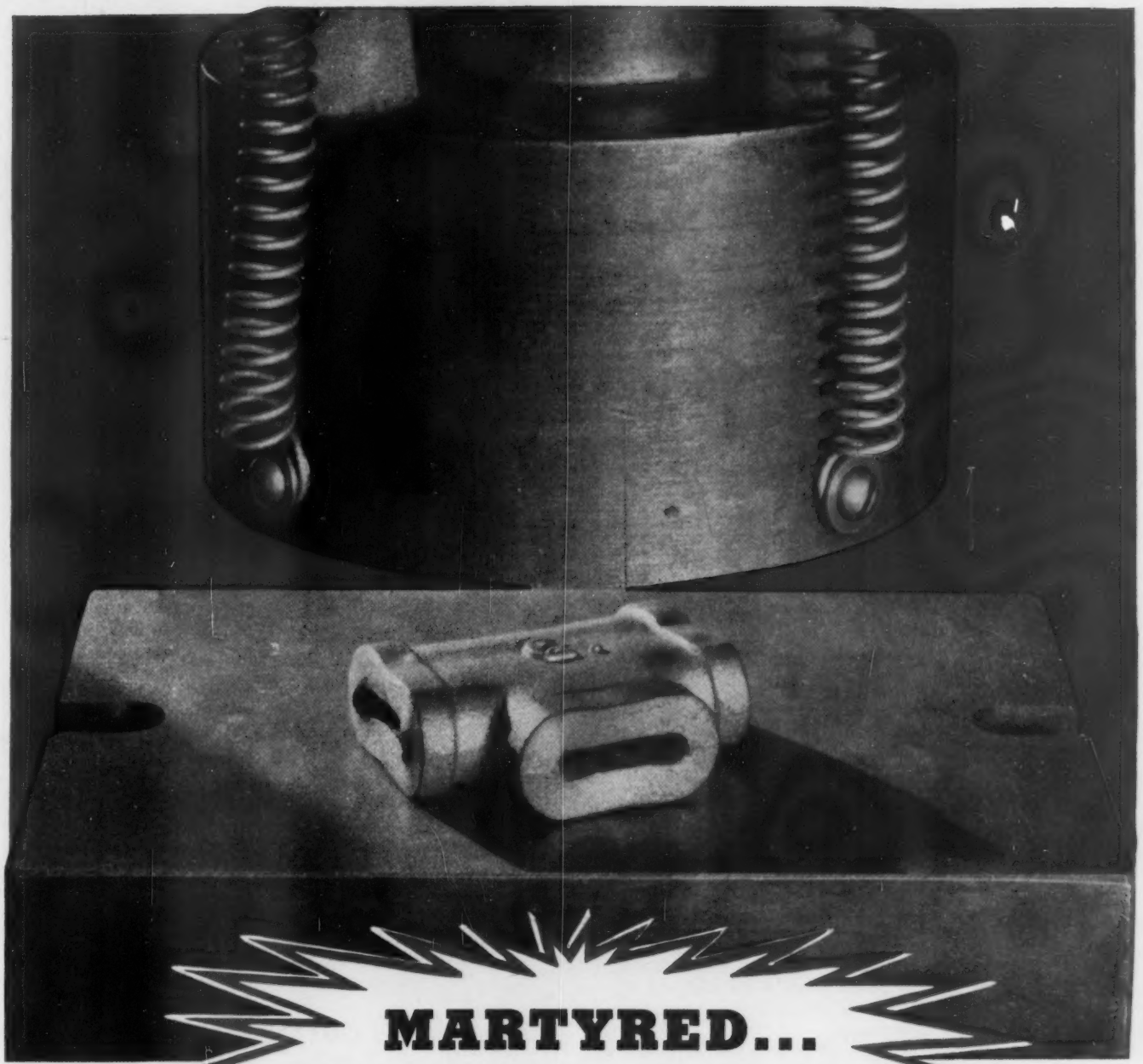
(*Continued from page 110*)

accuracy needed to prevent variation in the rate of timekeeping caused by change in elasticity of the hairspring with the increase and decrease in temperature. An engineering feat in watchmaking is the construction of the oscillating balance wheel, so designed that the friction on bearings remains the same no matter in what position the assembly is placed. Lubrication engineering has its part in supplying the assembly with oil which continues to flow, remain liquid and not evaporate during wide fluctuations in temperature and humidity.

Those of us who have read the Ivory soap ads know that Ivory soap is 99.44 per cent pure. This seems a high rate of purity. Yet, if the balance wheel in your watch, which controls its timekeeping ability, was no more accurate than that, your watch would vary more than five minutes a day and you would take it back to the jeweler. Many watches now vary only thirty seconds a week. With all of this degree of perfection, engineering problems still exist. We would like to know, for instance, how successfully to dry the air in a waterproof watch after working on it so that condensation and rust might be prevented.

Except for the legion of engineering problems, some of which still exist, the waterproof watch would have been produced many years ago. Among the still existing handicaps there is the problem of the stem which leads from the movement to the outside of the case. This rotating member is also slid in and out when the watch is set and is subject to some wear from dust. It is often baked in corrosive sweat for hours at a time and still must be able to function perfectly. I know of only one design which is 100 per cent perfect in keeping the moisture from invading the stem and this design is so bulky the public will not have it in any quantity.

How to keep the front and back of the wrist watch case waterproof offers another problem. Powerful wrenches tighten the back onto washers; but when the washers become bent and the case nicked, leakage follows. The front crystal is usually made of a plastic. Unfortunately, however, some plastics turn yellow, scratch, expand, contract, or become loosened under heavy pressure. In other instances plastic crystallizes and the center of the crystal will fall out. Even with perfect sealing of the watch, a change of temperature may cause the air inside of the watch case to be filled with moisture. This moisture condenses on the movement and the movement rusts. How to dry this air is one of the jeweler's major problems that some day experimentation will solve.



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Whether they serve on your household water pipes or in heavy-duty systems, Grinnell Fittings give you extra safety margin and extra assurance against trouble. This is but one typical example of the extra service values that consistently go with Grinnell Products . . . automatic sprinkler fire protection systems, prefabricated piping, unit heaters and others, alike. It illustrates why Grinnell is the outstanding name "Whenever Piping Is Involved"! Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

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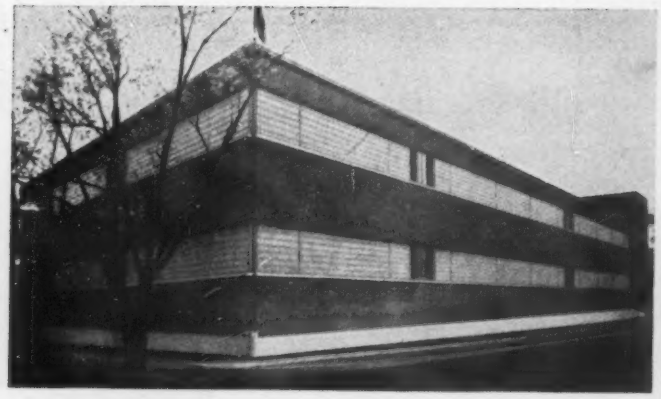
GRINNELL

WHENEVER **PIPING** IS INVOLVED



GTD **Leadership is Recognized**

To meet the shortage of accurate gages necessary to keep America's defense program in high gear, the government called on "G.T.D. Greenfield" to build additional plant capacity for the manufacture of these vital measuring tools.

What better proof of the accuracy and reliability of tools bearing the world-famous "G.T.D. Greenfield" trade mark shown above?

GREENFIELD TAP AND DIE CORPORATION GREENFIELD MASS.

GTD GREENFIELD

TAPS • DIES • GAGES • TWIST DRILLS • REAMERS • SCREW PLATES • PIPE TOOLS

PLACID PRODUCTION

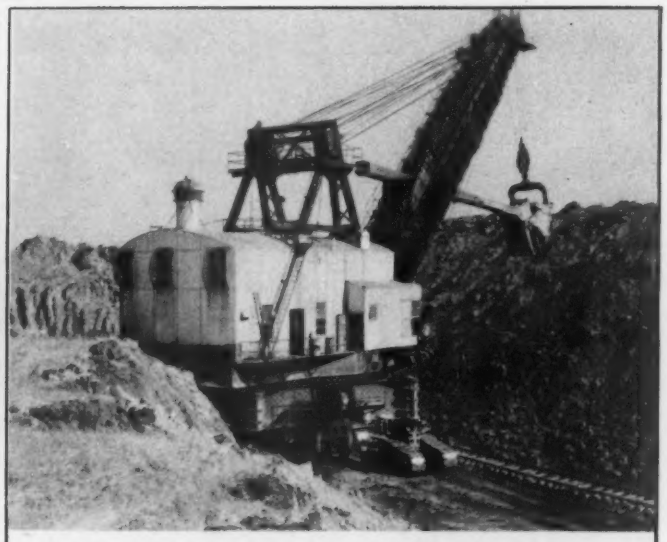
(Continued from page 112)

it, if the condenser should "breathe" or loosen the paper from the foil the condenser would lose its capacity and become useless; to prevent this the condensers are placed in a flat deep-drawn brass box, the cover put on under eighteen pounds pressure and soldered watertight, to prevent "breathing."

Steel breaker cams have to be lubricated, and if this lubricant gets on the contact points they quickly burn up, but these cams are made of many layers of canvas Bakelite heavily impregnated with graphite, giving perfect dry lubrication when rubbing against a hardened steel rubbing block.

The length of life of an ignition spark is very important, and to appreciate it make this experiment — strike a match and pass the flame rapidly against the underside of a piece of tissue paper. The paper will not ignite. But stop the flame, even for a fraction of a second, at any one place and the tissue will ignite instantly. This holds true in the igniting of fuels too, so to test the length of life of the spark in the magneto a chronoscope is used. Different sizes and makes of magnetos produce sparks varying from two and one-half one-thousandths of a second to ten one-thousandths of a second, the latter being able to ignite number three furnace oil.

The impulse coupling is important, because it has a spring in it which winds up, then kicks off, and whirls the magnet fast enough to make a good starting spark, with only one-quarter turn of the starting crank. The springs on other magnetos often break but these have gone seven million snaps without breaking.



TIREX CABLE

because it is both tough and dependable
was used for this shovel

Simplex Wire & Cable Co.
79 Sidney St., Cambridge, Mass.

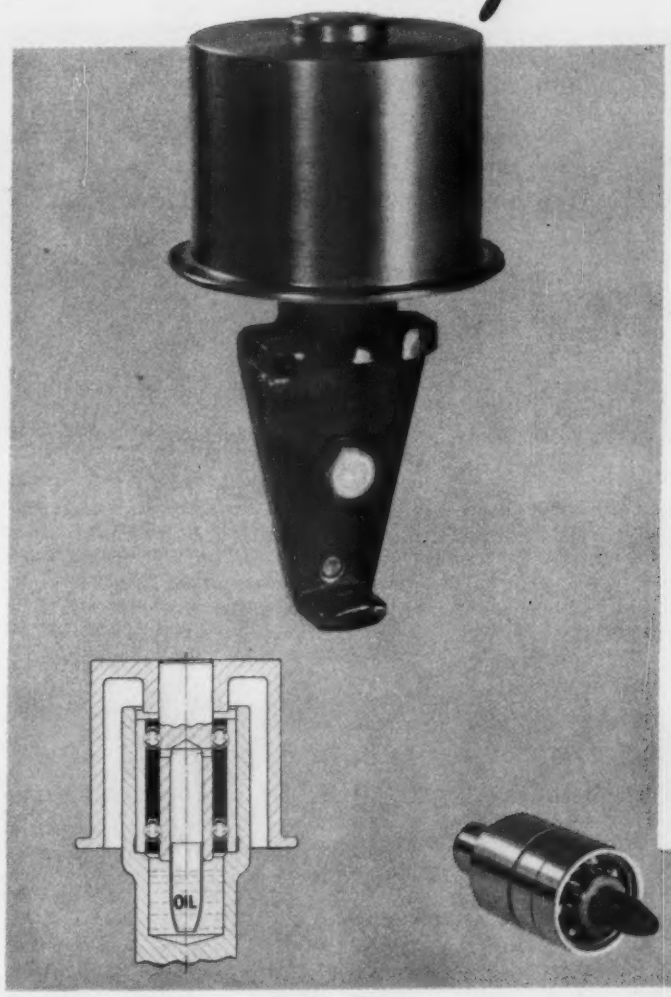
PRINTING

LETTERPRESS AND OFFSET

Of outstanding quality is produced by us daily for many buyers of good printing. Our forty years experience and modern equipment are available to you in caring for your printing problems

THE MURRAY PRINTING COMPANY
KENDALL SQUARE, CAMBRIDGE

inside it's always *raining*



● Yes, a continuous shower of tiny drops of oil inside this Tension Pulley Ball Bearing keeps balls and raceways automatically lubricated. It is the *first* anti-friction bearing with its own oil-circulating system—a permanent built-in feature, enabling it to run for a year or more without attention.

Since the products of New Departure are *ideas* as well as ball bearings, this company has developed many "famous firsts," has revolutionized mechanical design in many industries.

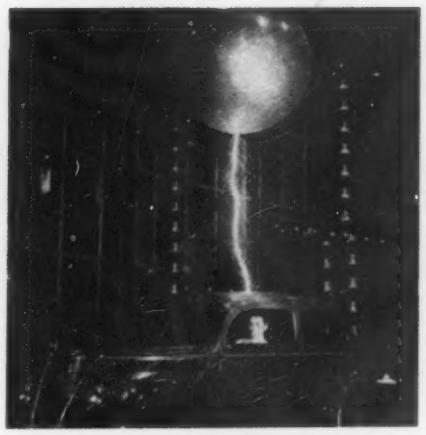
Nothing rolls like a ball. Ball bearings are used wherever shafts turn. Ask for your copy of that absorbing, superbly illustrated treatise: "Why Anti-Friction Bearings." New Departure, a division of General Motors, Bristol, Connecticut. Chicago and Detroit.

New Departure

. . THE FORGED STEEL BEARING

What do you know about electricity?

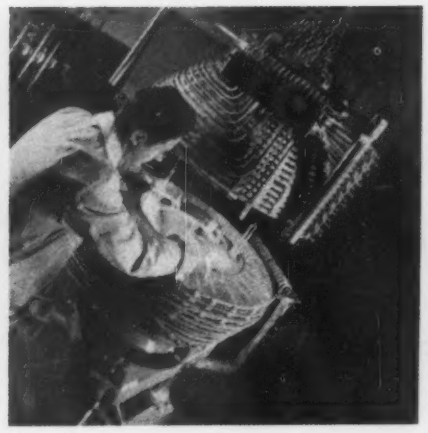
Check the correct answers to the questions below and see how many of these Westinghouse engineering activities you know



LIGHTNING EXPERIMENT

Recently, a Westinghouse engineer sat in his car while a 3,000,000-volt bolt of artificial lightning struck it. He was safe because the car body acts as:

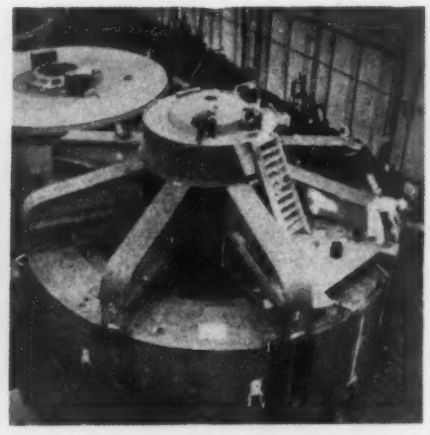
1. *A Helmholtz bell*
2. *A Faraday cage*
3. *A Maxwell's demon*
4. *A Wilson cloud chamber*



MASS SPECTROGRAPH

This mass spectrograph, used by engineers at the Westinghouse Research Laboratories, performs one of these functions:

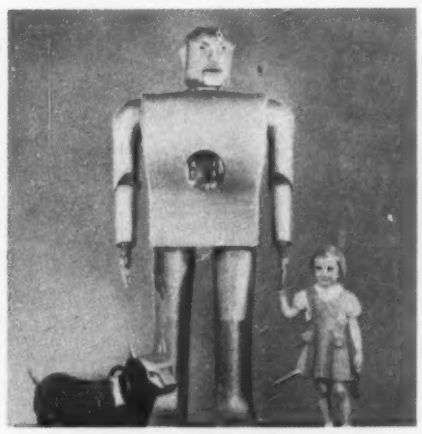
1. *Sorts atoms according to mass*
2. *Reveals spectra of stars*
3. *Produces U235*
4. *Measures amount of oxygen in air*



BIGGEST GENERATORS

Pictured above during construction is one of the three largest water-wheel generators in the world. All three are Westinghouse-built. Each will produce 108,000 kva, and is made for:

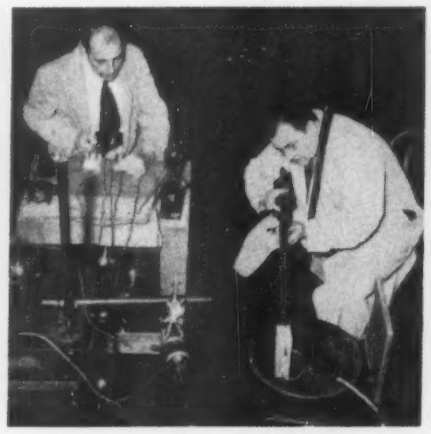
1. *Boulder Dam*
2. *Passamaquoddy*
3. *Dnieperstroy*
4. *Grand Coulee*



MECHANICAL MAN

This is the latest of a series of mechanical men made by Westinghouse engineers. He walks, talks, smokes cigarettes, raises his arms, counts on his fingers, distinguishes red and green lights. His name is:

1. *Volto*
2. *Mephisto*
3. *Elektro*
4. *Sambo*



FAST X-RAY

Westinghouse research engineers have developed a motion-stopping X-Ray that operates in:

1. *200th of a second*
2. *40th of a second*
3. *100,000th of a second*
4. *1,000,000th of a second*

PRECIPITRON

The Westinghouse Precipitron removes 95% of the solid matter from the air, including particles as small as pollen, microscopic dust, and smoke. It works by:

1. *Law of inverse squares*
2. *Capillary action*
3. *Infiltration*
4. *Electrostatic attraction*

HOW DID YOU DO?

Here are the answers. If you got 4 out of 6 of these Westinghouse activities right, you did O.K. If you got 5 out of 6 right, you deserve a cum laude. If you got all of them right, you're amazing.

Westinghouse

"THE NAME THAT MEANS EVERYTHING IN ELECTRICITY"

Lightning Experiment . . . A Faraday cage
Mass Spectrograph . . . . . Sorts atoms according to mass
Biggest Generators . . . Grand Coulee
Mechanical Man . . . . Elektro
Fast X-Ray . . . 1,000,000th of a second
Precipitron . . . Electrostatic attraction

Reg. U. S. Pat. Off.

Samson Cordage Works

Boston, Mass.

Herbert G. Pratt, '85, *Chairman of the Board*

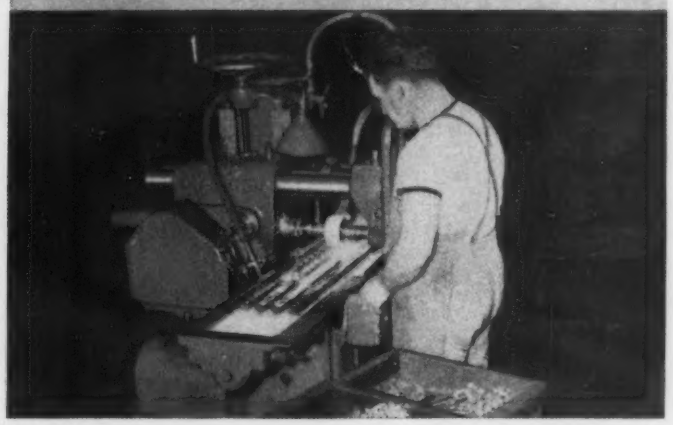
Manufacturers of braided cords of all kinds, including sash cord, clothes line, trolley cord, signal cord, shade cord, Venetian blind cord, awning line, etc., also polished cotton twines, ladder tape for Venetian blinds, and specialties.

SAMSON SPOT CORD

Reg. U. S. Pat. Off.

Our extra quality sash cord, distinguished at a glance by our trade-mark, the colored spots. Especially well known as the most durable material for hanging windows, for which use it has been specified by architects for nearly half a century.

BROWN & SHARPE ELECTRICAL CONTROL
—for Rapid and Precise Milling



Outstanding for —

B·S

Write for details
Brown & Sharpe Mfg. Co., Providence, R. I.

- Rapidity and Precision of Movements
- Flexibility of Performance
- Smooth and Quiet Operation
- Safety Protection
- Dependability and Lasting Accuracy

BROWN & SHARPE

SUGAR MANUFACTURE

(*Continued from page 115*)

The rotation of a wire-gauze basket in a vertical spindle (at 1000 R.P.M.) provides the centrifugal force which separates the sugar crystals from the liquor. From the basket the liquor flows outward through the sieve openings, while the crystals settle to the bottom. This liquor returns to a vacuum pan for reboiling; the crystals are dried by air and packed into jute bags as "raw" sugar.

The characteristic amber color, odor, and moisture of the raw sugar is due to a thin film of the mother liquor adhering to the crystals. The American public demands that this two to five per cent "impurity" be removed. In answer, ships ply across the Atlantic and Pacific carrying raw sugar to the refineries on the coasts.

Inside one of these refineries the series of operations are very similar to those of the raw sugar mill. Briefly let us glance at this metamorphosis from amber to sparkling white. Now on conveyor belts, the sugar is sampled. In minglers the contents are softened with heavy sugar and water syrup. Then, while subjected to centrifugal action, the crystals are "melted" again by hot water.

Clarifying and decolorizing are effected by steam heat, violent agitation, lime, the kieselguhr effect, rapid filtering and complete neutrality. Then, after percolating through towers of "bone char" two stories tall, the liquor emerges close to the goal of absolute purity. It is drawn into vacuum pans, converted into crystals, and centrifuged. The transformation is now complete: the product is refined sugar.

• Correct, conventional, simplified drawings of all the most widely used bolts, nuts, rivets, and other standard machine fasteners are shown in the "R B & W Handbook of Common Machine Fasteners," a 16-page booklet that will be sent to you free upon request. This handy reference, which will fit inside your drawing instrument case, contains no actual dimensions nor specifications, but is offered merely as a guide for the proper representation of standard fasteners on assembly and detail drawings.

More than 30,000 students, instructors, and professional draftsmen have already received this booklet. Just drop a card to our Port Chester address.

R B & W, for 96 years a leader in the development of industrial fastenings, manufactures a complete line of bolts, nuts, rivets, and other threaded fastenings of all standard and many special types.

EMPIRE

RUSSELL, BURDSALL & WARD
BOLT AND NUT COMPANY
PORT CHESTER, N.Y. ROCK FALLS, ILL. CORAOPOLIS, PA.

188-3

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Lafayette's SPECIAL SERVICE DEPARTMENT was inaugurated to place our tremendous stocks of parts, components, tools and supplies at your service for immediate delivery. The response to our announcement of this SPECIAL SERVICE DEPARTMENT to Engineers in the Boston area has been most gratifying.

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Our Mr. Lang calls at M.I.T. twice daily. Call Hubbard 0474 and he'll be glad to make an appointment to see you.

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Surveying Instruments

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Telephone ARNold 1770

Write For New Adjustment Book

SITUATIONAL THINKING . . .

(*Continued from page 105*)

such compensating factors as increase in pay, simplification of work procedures, or improvement in machinery.

B. Management resented what they considered an attempt by the union to interfere with the scheduling of production.

Once these sentiments had been clearly recognized, the air was cleared by asking each side to make an explicit statement of intention on these points. Such statements, "for the record," served as a mechanism to de-emotionalize the situation. Management disavowed any desire to introduce the stretch-out. The union officials disavowed any intention to interfere with management prerogatives. Now the stage was set for focussing attention on the technical problem-aspect of the situation, that of defining a mutually acceptable work-load, per-man, per-hour, *under present conditions*.

In the above case, when the problem had been clearly defined and divorced from ambiguous statements and emotional reactions, it was quickly settled. Furthermore, attention was constructively centered on the evolving aspects of the situation. The work-load was not frozen arbitrarily, but the way was left open for future adjustment. If current conditions were improved by the introduction of more efficient machinery or the simplification of work-procedures, management might initiate discussion with regard to corresponding changes in the work-load. On the other hand, if the situation should deteriorate, owing to the obsolescence of machinery or the appearance of other adverse conditions, the workers might initiate discussion with reference to corresponding changes in the work-load.

Situational thinking, as exemplified by the above case, is in the first place the power of listening to what is *not* said, where the suggested content is "more than meets the ear." The trained observer listens attentively for the emotional implications of statements, without allowing himself to become emotionally involved. When he sees the underlying difficulties he can help to clarify the situation by eliminating misunderstandings, which otherwise merely complicate the immediate issue.

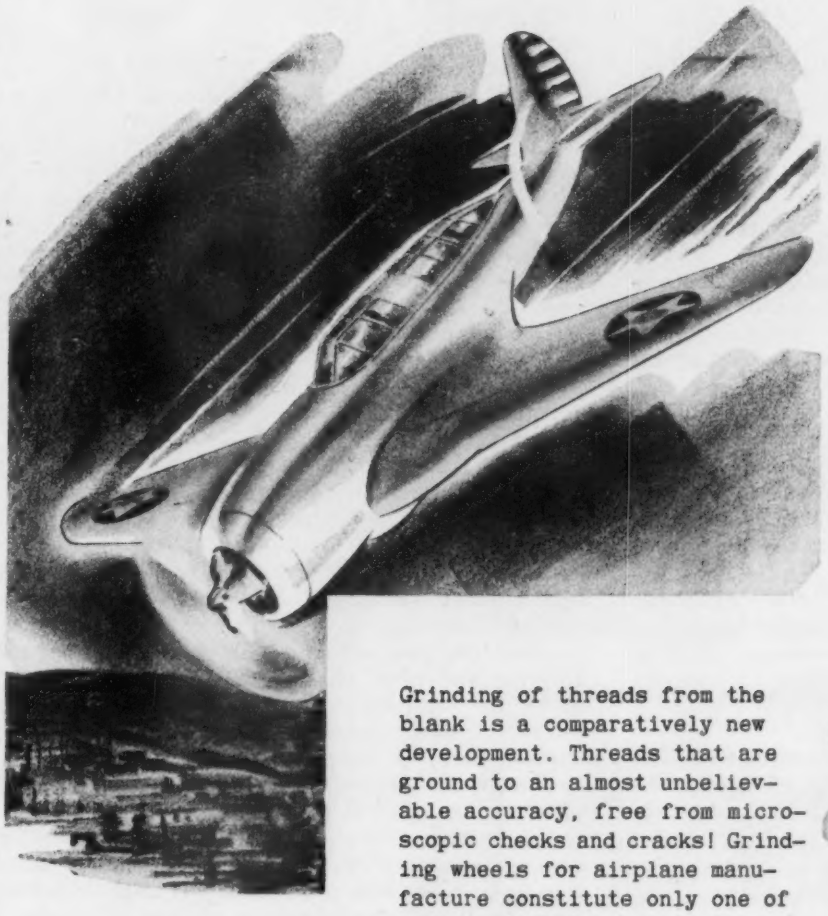
Secondly, when irrelevant difficulties have been put aside, he can help each participant explicitly to re-state his central demands in terms that more appropriately reflect the situation.

On the basis of such objective statements, the third stage can be reached — that of getting each party attentive to the other's basic needs. Each can broaden his view of the situation to include that of the other, so that both parties are looking at a mutually inclusive picture. This picture of the situation can include sentiments as well as logic since both are now articulated and objectified.

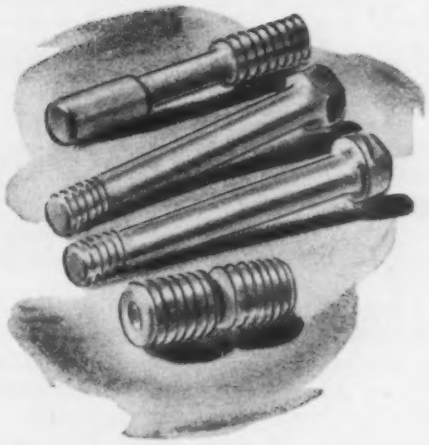
Only after this mutually increased range of vision has been achieved can the participants meet at a deeper level of social integration below the surface meaning of words and antagonistic states of mind. In the expanded social situation, individuals no longer need to squabble over words and prejudices but can become interested in developing collaborative social techniques. Policies, not personalities, then become central issues.

Finally, a situationally minded observer can demonstrate that social situations are evolving processes. Thus in establishing a mutually satisfactory work-load, the satisfaction attaches not primarily to the particular formula as "the right answer." It is more securely founded on a mutual recognition that each will deal fairly with the variables which are bound to call for progressive adjustment in the evolving situation. Furthermore, such shared activity in problem-solving promotes collaboration through joint audits of process whenever needed. In this cooperative endeavor the intangible factors of mutual hostility and distrust which threatened to divide management and labor give place to a confidence bred from shared success in developing adequate means of control.

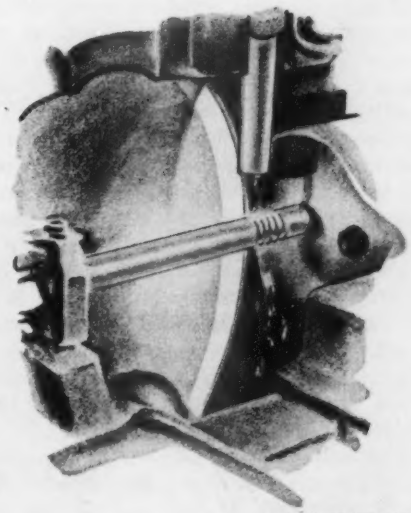
What holds a dive bomber together at 500 M.P.H.?



The answer is design and construction and materials and craftsmanship. But accuracy and finish of parts are also important in building a plane to withstand terrific speeds and that depends on grinding. Vibration is minimized by grinding all moving parts of the power unit to extreme accuracy. Safer and stronger threaded parts are ground with special grinding wheels such as are made by The Carborundum Company.



Grinding of threads from the blank is a comparatively new development. Threads that are ground to an almost unbelievable accuracy, free from microscopic checks and cracks! Grinding wheels for airplane manufacture constitute only one of many contributions made to industry by Carborundum during its fifty-year existence.



In fact there isn't an industry that has not been benefited by grinding. No matter what industry you go into after graduation, you may run into a grinding problem. And Carborundum Engineering Service will be ready to help you solve it! The Carborundum Company, Niagara Falls, New York.

Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company.

CARBORUNDUM
REG. U.S. PAT. OFF. BRAND
ABRASIVE PRODUCTS
50 YEARS OF SERVICE TO ALL INDUSTRY

"PICK YOUR JOB, SIR"

(*Continued from page 118*)

purchase orders for the major equipment. At least, let's try to. For, like lots of folks, owners sometimes weaken at the crucial point of signing up for heavy commitments; sometimes you feel that they haven't really worried about things until now, as you put the contracts before them and say, "Sign here." Restrained grins of content, subdued sighs of relief mark the atmosphere of the consultant's office; men have been known to go take a drink or two when the good news is received — the owner has signed!

We insist on a good contractor, of course; a man with a record of finishing his jobs properly and on time. Such a contractor, you may be sure, has the courage, ingenuity, and inspiring personality requisite for any hard building job.

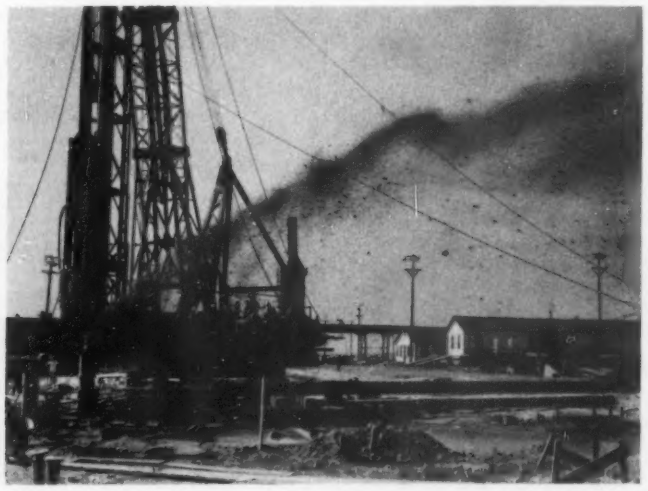
Any of you who think you qualify to be contractor? Good man; more power to you! But, not to mislead, how are you at poker? Are you good at taking tricks with a poor hand, occasionally? Are you good at thwarting that misnamed old harridan, "Good Old Mother Nature," with her rains and frosts, her high winds and quicksands, and her bed rock which she shows by the borings to be at grade ten but sneakily drops to grade five when she finds you wish to put a footing at that point?

Why not look over a few of the jobs the contractor has to fill at this stage: superintendent, general foreman, subforemen, line-and-grade-engineer, material clerk, timekeepers, and, not forgetting, the water boy. You should qualify somewhere within this range. *And the "got to make a dollar" motive that whips them all on should be good medicine for a young man in search of that prime requisite of an engineer, practicality.*

Some day, in a drunken moment perhaps, a modern Doré will catch the amazing confusion of sand piles, lumber stacks, shacks, barriers, half-built masonry masses, and incomplete steel frames of the nightmarish picture of a building job in its early stages of construction — a composition that rivals the fall of Babylon or the details of a train wreck.

Some Stravinsky will sense and record the harsh cacophony of hoists, pile drivers, mixers, paving breakers, riveters, and screaming saws, rendering this discord into a permanent, horrible record of how things sound as men build their structures. To you, it is a composition of sweet beauty, executed to the orchestration of noble sounds, as you view the unsightly pile of steel beams that cost you a box of cigars for the shifting gang to get placed on time. And you revel in the music of the coughing excavation pump, which you nursed half the night to get better delivery so that it could dry the pit for your diggers by the morning.

Courtesy Boston Edison Co.



Off in some dirty corner selected for the high decibel rating of the ambient atmosphere, seated at a home-made bench in a structure designed after Chic Sale, is a harrassed person dexterously juggling a roll of plans, a telephone and a sheaf of invoices; meanwhile exhorting an audience of subcontractors, foremen and various lesser lights.

That's you — having passed through the chairs and occupying the exalted position of Resident Engineer — or your title may be Superintendent according to how the job is organized. Anyway, you're holding the bag. Your duties are simple: just to see that materials get on the job in time, to see that these materials are put into place in proper time sequence and in the relations established by the drawings, and to finish the whole job on time and within the budget.

True, this simple definition has ramifications. Your bosses add to the total pay roll, embracing the owner's clerks, purchasing agents, legal advisors, and assistants to the Third Assistant Vice-President, all of whom you must keep happy.

Back in the office of your real boss, the consultant, there has been assigned a swarm of gnats to pester you with letters and telegrams demanding promptness in the matter of some dozen reports. They engulf you with advice, usually after the particular detail is already built anyway; but reams of correspondence are required to clear things up.

Each day you are given a stack of invoices to check, approve and allot to the proper budget item. You battle for material deliveries by hounding manufacturers' offices, freight clerks, and by even shifting gangs, with impartial tenacity.

You settle disputes. "I want to use the doggoned pipefitter's staging to put up my wall fixtures, and the selfish so-and-so says he wants to take it down," complains the electrician, so you talk to the recalcitrant pipe man, telling him what a fine guy that electrician is. Who was it who mentioned the wisdom of Solomon and the guile of a serpent as needful qualifications to get things done? The Resident Engineer on the Tower of Babel, we'll bet.

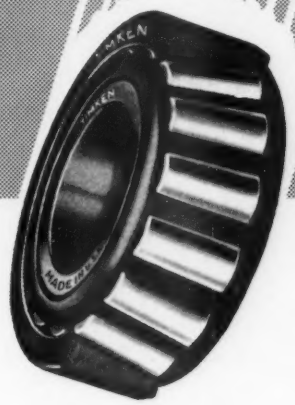
And decisions. Do you remember being told that engineering is a science of deep mental effort, not adapted to quick decisions because each decision had to be preceded by orderly, unhurried thinking? Phooey! Your job requires many quick decisions that are sound, and, above all, firm; for you can't weaken.

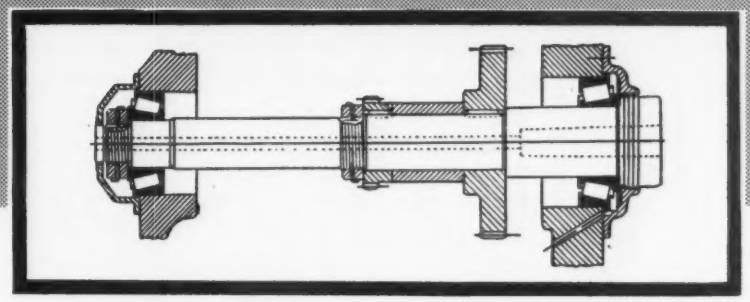
Technically your subordinates, the contractor's force chase you like a slave, demanding information on materials and methods so they can tear ahead. You know they are justified, for you learn that it costs money to keep a good man waiting — or his gang.

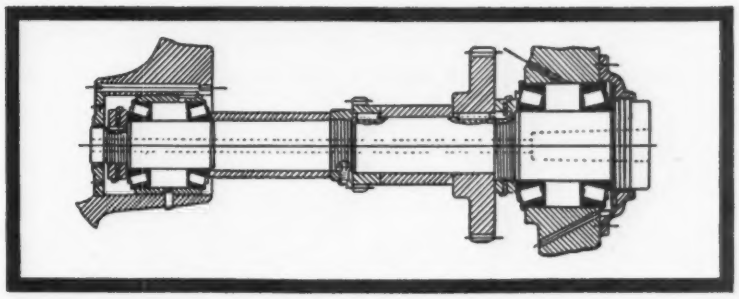
So you are right busy and consequently happy. No one would be fool enough to offer you another job. They see what a kick you are getting from this one. And, as far as I can see, the disease is incurable; once infected with the construction virus, you're no good at anything else.

The Pharaohs' pyramids, Roman aqueducts, cathedrals of Europe, American skyscrapers, the Norris Dam, the Washington Bridge and all the other fine monuments your profession has built with all the heart-breaking cares and heart-warming thrills that go with any great accomplishments, can inspire you. Think of the fun that good men had building these fine things — and think of the fights.

What bearings would you specify for a Machine Tool Spindle?







Suppose you were designing a heavy-duty lathe for precision work—where tolerances as close as one ten-thousandth of an inch had to be held; where heavy cuts would be the rule. How would you mount the work spindle?

If you knew your bearings you would mount the spindle on TIMKEN Bearings front and rear. Then you would be assured of permanent spindle rigidity; freedom from chatter under any cutting load; any spindle speed; any rate of feed. In other words, *accuracy*. The spindle would turn smoothly because there would be no friction to hamper its movement. Power demands would be lower. Radial, thrust and combined loads would be carried safely under all operating conditions.

By following the above procedure you would be doing what an overwhelming majority of the leading heavy-duty machine manufacturers have been doing for a long time.

If you would like to know more about the application of TIMKEN Bearings in all kinds of machine tools as well as in many other kinds of equipment write for a free copy of the Timken Reference Manual. Know your bearings—be a better engineer.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

TIMKEN
TAPERED ROLLER BEARINGS

G-E Campus News

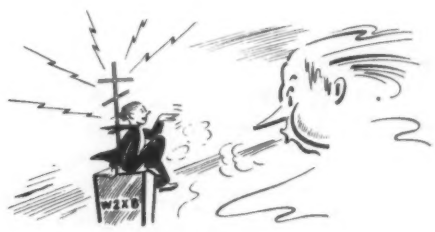
I KNOW!

IF THE steel for an automobile travelling between Chicago and Los Angeles at 60 mph was cold-rolled at a speed of 42 mph, how far is it from Bangor, Maine, to Bankok?

So far as we know there's no answer to this problem. But then, a few years ago there was no answer to the problem of cold-rolling steel strip at these speeds either.

G-E amplidyne control solved this problem, enabling a Pennsylvania steel plant, the largest, highest-powered cold-rolling mill for tin-mill products in the world, to roll out strip at speeds up to 3850 feet per second, or more than 43 miles per hour!

G-E motors to the tune of 11,400 hp respond to the precision control of G-E amplidyne circuits in driving the rolls of the mill at this speed.



TELEBOX

WHEN Dame Nature goes to work on a television antenna with rain, sleet, and snow, she can cause no end of transmission trouble.

G-E television engineers, however, circumvent weather changes by housing the antenna within an electrically heated box. This prevents seeping moisture from freezing on the antenna during cold weather and interfering with the normal patch of high-frequency current flow.

The antenna, at the top of a 128-foot transmitting tower in the heart of Schenectady, relays the picture waves to G.E.'s main transmitting station in the Helderberg hills 12 miles away.

On top of the box for relaying the accompanying FM sound is another antenna which also acts as a lightning rod to protect the tower and relay equipment.

RESEARCH INC.

HOW a heavy English bulldog and a brawny Irish washerwoman substantiated the findings of years of research is described with an order for fifty miles of Formex wire recently received by General Electric.

The customer was considering the use of Formex wire as a substitute for wire whose insulation had rotted after two or three years of use, exposing the bare copper. The railroad's signal engineer was "from Missouri" and wanted to see for himself whether Formex wire insulation could "take it."

Two 50-foot lengths were strung up. One was equipped with a metal ring, to which a bulldog was attached on a leash. The other became a washerwoman's clothesline. Several weeks later, after the bulldog had tugged against every inch of his wire and the washerwoman had pinched her wire with clothespins from end to end, the insulation of both lengths was still in perfect condition.

GENERAL ELECTRIC

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